



# **User's Guide for the EPA Nonroad Emissions Model Draft NONROAD 2002**

# **User's Guide for the EPA Nonroad Emissions Model Draft NONROAD 2002**

Assessment and Standards Division  
Office of Transportation and Air Quality  
U.S. Environmental Protection Agency

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ENVIRON International Corporation  
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## TABLE OF CONTENTS

|  | Page       |
|--|------------|
| <b>1. INTRODUCTION</b> .....   | <b>1-1</b> |
| Overview of the EPA Nonroad Emissions Model .....                                    | 1-2        |
| Equipment Types .....  | 1-2        |
| Pollutants Reported .....  | 1-2        |
| Geographic and Temporal Coverage .....   | 1-2        |
| Model Components .....   | 1-3        |
| Model Inputs .....   | 1-5        |
| Output Options .....   | 1-6        |
| Technical Documentation .....  | 1-7        |
| Future Model Updates .....   | 1-8        |
| To Stay Informed .....   | 1-8        |
| Conventions Used in the User's Guide .....   | 1-8        |
| Organization of the User's Guide .....   | 1-10       |
| <b>2. GETTING STARTED</b> .....  | <b>2-1</b> |
| Quick Start .....  | 2-1        |
| System Requirements for Running the NONROAD Model .....                              | 2-1        |
| Installing the NONROAD Model .....   | 2-2        |
| Attaching the Reporting Utility Databases .....                                      | 2-2        |
| Reinstalling the NONROAD Model .....   | 2-3        |
| <b>3. GRAPHICAL USER INTERFACE</b> .....   | <b>3-1</b> |
| Quick Start .....  | 3-1        |
| General Description .....  | 3-2        |
| Moving Around in the Graphical User Interface .....                                  | 3-3        |
| Creating an Option File .....  | 3-5        |
| Opening and Naming an Option File .....  | 3-5        |
| Defining a Report Title .....  | 3-6        |
| Defining Fuel Specifications, and Ambient Temperatures and Stage II Effectiveness .. | 3-7        |
| Defining the Modeling Period .....   | 3-9        |
| Defining the Modeling Region .....   | 3-10       |
| Defining Source Categories .....   | 3-12       |
| Saving an Option File .....  | 3-15       |
| Running and Viewing a Modeling Scenario .....  | 3-15       |
| Advanced Options .....   | 3-17       |

|  |            |
|--|------------|
| Examples of Changing Geographic Allocation .....         | 3-17       |
| Exiting the Graphical User Interface .....               | 3-19       |
| <b>4. CORE MODEL .....</b>                               | <b>4-1</b> |
| Quick Start .....  | 4-1        |
| General Description .....                                | 4-2        |
| Creating an Option File .....                            | 4-2        |
| Modifying /RUNFILES/ .....                               | 4-4        |
| Modifying /OPTIONS/ .....                                | 4-5        |
| Modifying /PERIOD/ .....                                 | 4-7        |
| Modifying /REGION/ .....                                 | 4-9        |
| Modifying /SOURCE CATEGORY/ .....                        | 4-11       |
| Modifying the /POP FILES/ and /ALLOC Files/ Packet ..... | 4-12       |
| Saving an Option File .....                              | 4-15       |
| Running the Core Model .....                             | 4-15       |
| Error Stop Feature .....                                 | 4-16       |
| <b>5. REPORTING UTILITY .....</b>                        | <b>5-1</b> |
| Quick Start .....  | 5-1        |
| General Description .....                                | 5-2        |
| The Reporting Utility Menus .....                        | 5-2        |
| Import, Delete, and Re-Attach .....                      | 5-4        |
| Importing Core Model Output .....                        | 5-4        |
| Removing a Simulation .....                              | 5-6        |
| Attaching the Reporting Utility Databases .....          | 5-7        |
| Report Types .....                                       | 5-8        |
| User Specifications .....                                | 5-9        |
| Generating Reports .....                                 | 5-12       |
| Running a Report .....                                   | 5-12       |
| Viewing a Report in Print Preview .....                  | 5-12       |
| Exporting to Excel .....                                 | 5-14       |
| Comparing Model Runs .....                               | 5-15       |
| Compacting and Repairing Databases .....                 | 5-17       |

|  |            |
|--|------------|
| <b>6. ADVANCED TOPICS</b> .....                    | <b>6-1</b> |
| Introduction .....                                 | 6-1        |
| How Data Are Grouped in the Nonroad Model .....    | 6-2        |
| Input Data Packets and Data Files .....            | 6-4        |
| Review of Previously Described Packets .....       | 6-4        |
| Runfiles Packet .....                              | 6-5        |
| Activity .....                                     | 6-5        |
| Alloc XREF .....                                   | 6-7        |
| Regions .....                                      | 6-10       |
| Seasonality .....                                  | 6-11       |
| Technology .....                                   | 6-12       |
| Population Files Packet .....                      | 6-15       |
| Growth Files Packet .....                          | 6-18       |
| Allocation Files Packet .....                      | 6-22       |
| Modifying Inputs for Subcounty Runs .....          | 6-24       |
| Emissions Factors Files Packet .....               | 6-28       |
| Data Files in the /EMFAC FILES/ Packet .....       | 6-29       |
| Deterioration Factors Files Packet .....           | 6-32       |
| Data Files in the /DETERIORATE FILES/ Packet ..... | 6-33       |
| PM Base Sulfur Packet .....                        | 6-34       |
| Editing Input Data Packets and Files .....         | 6-34       |
| Making Multiple Model Runs .....                   | 6-35       |
| <b>7. TROUBLE SHOOTING</b> .....                   | <b>7-1</b> |
| Message File .....                                 | 7-1        |
| Data File Relationships .....                      | 7-4        |
| Allocation Files .....                             | 7-4        |
| Population Data .....                              | 7-4        |

## APPENDICES

|   |
|---|
| Appendix A: FIPS Codes  |
| Appendix B: Source Classification Codes (SCC) and Definitions |
| Appendix C: Examples of Standard Reports                      |
| Appendix D: Examples of Model Comparison Reports              |

## FIGURES

|             |   |      |
|-------------|---|------|
| Figure 1-1. | Nonroad Model Flowchart . . . . .   | 1-4  |
| Figure 3-1. | Graphical User Interface icon. . . . .  | 3-3  |
| Figure 3-2. | Initial graphical user interface screen . . . . .   | 3-3  |
| Figure 3-3. | Options screen . . . . .  | 3-7  |
| Figure 3-4. | Period screen . . . . .   | 3-9  |
| Figure 3-5. | Region screen . . . . .   | 3-11 |
| Figure 3-6. | Sources screen . . . . .  | 3-13 |
| Figure 3-7. | Model submenu screen . . . . .  | 3-16 |
| Figure 3-8. | Geographic allocation screen . . . . .  | 3-18 |
| Figure 4-1. | Portion of the <i>TEMPLATE.OPT</i> file . . . . .   | 4-4  |
| Figure 4-2. | TRAVIS.OPT/RUNFILES/ packet . . . . .   | 4-5  |
| Figure 4-3. | Modified /OPTIONS/ packet . . . . .   | 4-7  |
| Figure 4-4. | Modified /PERIOD/ packet . . . . .  | 4-8  |
| Figure 4-5. | Modified /REGION/ packet . . . . .  | 4-10 |
| Figure 4-6. | Modified /SOURCE CATEGORY/ packet . . . . .   | 4-12 |
| Figure 4-7. | Modified /POP FILES/ packet . . . . .   | 4-13 |
| Figure 4-8. | Modified /ALLOC FILES/ packet . . . . .   | 4-14 |
| Figure 4-9. | DOS window showing successful model run . . . . .   | 4-16 |
| Figure 5-1. | Initial report utility screen . . . . .   | 5-3  |
| Figure 5-2. | Import core model data screen . . . . .   | 5-5  |
| Figure 5-3. | User-specified report options screen . . . . .  | 5-10 |
| Figure 5-4. | Report title area . . . . .   | 5-13 |
| Figure 5-5. | Report options for comparing two model runs . . . . .   | 5-16 |
| Figure 5-6. | Report options for comparing two model runs by population and fuel . . . . .  | 5-17 |
| Figure 5-7. | Identify a directory for temporary storage screen . . . . .   | 5-19 |
| Figure 6-1. | Option file showing packet identifiers and terminators . . . . .  | 6-3  |
| Figure 6-2. | /ALLOC FILES/ packet . . . . .  | 6-23 |
| Figure 6-3. | Modified <i>TX.pop</i> file with population estimates for 2-stroke residential lawn mowers in Travis County . . . . . | 6-26 |
| Figure 6-4. | Modified <i>TX_house.alo</i> file showing housing of Austin. . . . .  | 6-26 |
| Figure 6-5. | Modified /REGION/ packet showing subcounty region . . . . .   | 6-27 |
| Figure 6-6. | /EMFAC FILES/ packet . . . . .  | 6-29 |
| Figure 6-7. | /DETERIORATION FILES/ packet . . . . .  | 6-32 |
| Figure 6-8. | Batch file <i>milg.bat</i> . . . . .  | 6-35 |
| Figure 7-1. | Output message file . . . . .   | 7-2  |

## Chapter 1

# Introduction

Air pollution in the United States results from the emission of a wide variety of manmade and natural pollutants such as volatile organic compounds (VOC), nitrogen oxides (NO<sub>x</sub>), air toxics, and particulate matter (PM). Under the Clean Air Act, the U.S. Environmental Protection Agency (EPA) is given specific responsibilities to reduce the emissions of pollutants from a range of sources in order to provide clean and healthy air in the United States.

Generally speaking, the EPA classifies anthropogenic (manmade) emissions into three broad categories, mobile, stationary (point), and area sources. Mobile source emissions are further disaggregated into on-road (e.g., cars, trucks, and motorcycles) and nonroad emission categories. Because of the significant contribution of nonroad emission sources to the total mobile source emission inventory, it has become critical over the past several years for the EPA to provide state and local pollution control agencies with the ability to easily create and project accurate, reproducible inventories of nonroad emissions to satisfy the specific requirements of the Clean Air Act Amendments of 1990.

Nonroad emissions result from the use of fuel in a diverse collection of vehicles and equipment, including vehicles and equipment in the following categories:

- recreational vehicles, such as all-terrain vehicles and off-road motorcycles;
- logging equipment, such as chain saws;
- agricultural equipment, such as tractors;
- construction equipment, such as graders and back hoes;
- industrial equipment, such as fork lifts and sweepers;
- residential and commercial lawn and garden equipment, such as leaf and snow blowers;
- recreational and commercial marine vessels, such as power boats and oil tankers;
- locomotive equipment, such as train engines; and
- aircraft, such as jets and prop planes.

With the exception of aircraft, all categories of nonroad vehicles and equipment were unregulated by the EPA prior to the mid-1990s.

In a report issued by the EPA in 1991<sup>1</sup>, the agency reported that nonroad vehicles and equipment were a significant source of VOC, NO<sub>x</sub>, and PM emissions. The report showed that in some

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<sup>1</sup>EPA, *Nonroad Engine and Vehicle Emission Study*, EPA-21A-2001, November 1991.

areas of the country, nonroad emissions contributed to as much as a third of the total mobile source NO<sub>x</sub> and VOC inventory and over two-thirds of the mobile source PM inventory.

To assist states and local regulatory agencies in the creation of accurate nonroad emission inventories, the EPA has developed a nonroad emissions model which covers all areas of the nation. This document describes the 2002 limited release version of the model.

## **OVERVIEW OF THE EPA NONROAD EMISSIONS MODEL**

### **Equipment Types**

This version of the nonroad emissions model predicts emissions for all nonroad equipment categories listed above with the exception of commercial marine, locomotive, and aircraft emissions. The model includes more than 80 basic and 260 specific types of nonroad equipment, and further stratifies equipment types by horsepower rating. Fuel types include gasoline, diesel, compressed natural gas (CNG), and liquefied petroleum gas (LPG).

### **Pollutants Reported**

The NONROAD model estimates emissions for six exhaust pollutants: hydrocarbons (HC), NO<sub>x</sub>, carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), sulfur oxides (SO<sub>x</sub>), and PM. The user selects among five different types for reporting HC — as total hydrocarbons (THC), total organic gases (TOG), non-methane organic gases (NMOG), non-methane hydrocarbons (NMHC), or volatile organic compounds (VOC). Particulate matter can be reported as PM of 10μ or less (PM<sub>10</sub>) or PM of 2.5μ or less (PM<sub>2.5</sub>). The model also estimates emissions of non-exhaust HC for four modes — diurnal, refueling spillage, vapor displacement, and crankcase emissions. All emissions are reported as short tons (i.e., 2000 lbs).

### **Geographic and Temporal Coverage**

In each run of the model, the user selects what geographic area(s) are to be included. At the broadest level, the model estimates national total emissions. More commonly users will specify emissions by state, or for one or more counties within a state. At the most detailed level, the user can estimate sub-county emissions; however, this is an advanced feature and the user must supply sub-county input data. Thus the model is capable of estimating emissions for nonattainment areas which may consist of multiple counties or sub-counties in one or more states.

The NONROAD model can estimate current year emissions for the specified geographic area as well as project future year emissions and backcast past year emissions for calendar years 1970 through 2050. In estimating future year projections and in backcasting, the model includes growth and scrappage rates for equipment in addition to a variety of control program options. The model can calculate emissions for a variety of time periods — an entire year, one of four seasons, or any particular month. Emissions for the period selected are estimated either for the total period or for a typical day (weekday or weekend) in that period.

## **Model Components**

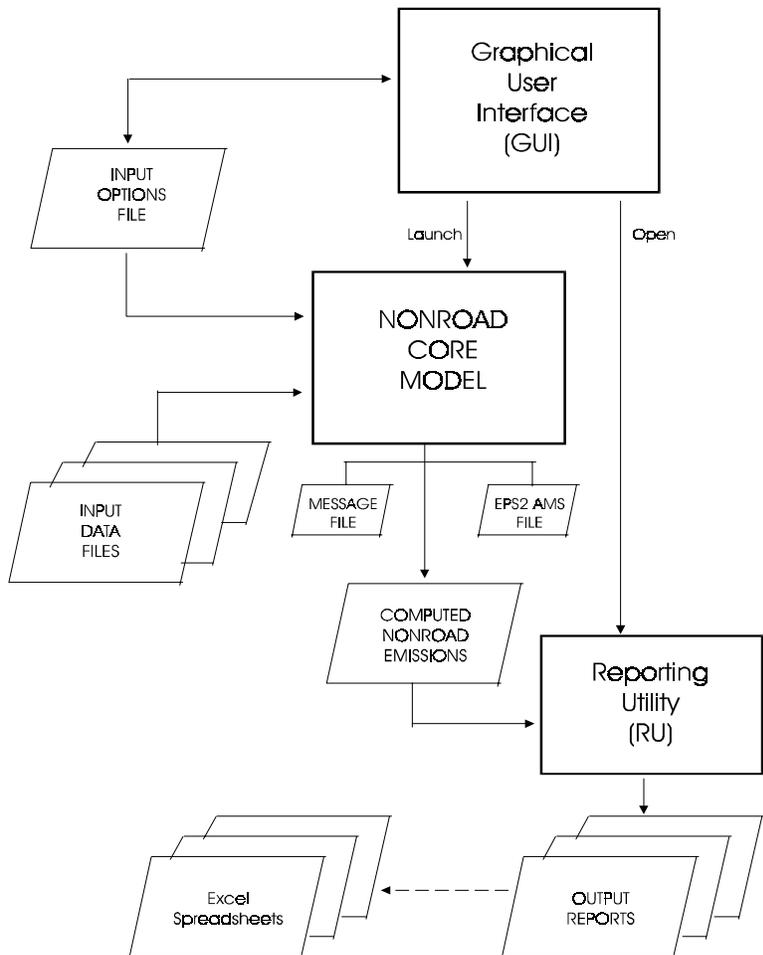
As shown in Figure 1-1, the NONROAD model consists of three separate components: a graphical user interface written in Visual Basic, the core model written in Fortran, and a reporting utility written in Microsoft ACCESS. The install utility supplied easily installs all three components of the model onto a personal computer.

The primary purpose of the user interface is to provide the user with an easy method to specify the options for a model run. With simple Windows-type screens and pull-down menus, the user can quickly set up, execute, and view a modeling scenario. Once the model options are specified, the user can then run the Fortran core model from within the interface, and then can move directly to the reporting utility to view and summarize the modeling results.

The core model of NONROAD, written in Fortran, contains all of the algorithms used by the model for calculating emissions estimates. The core model can be operated as a stand-alone application; however, as a stand-alone application it requires some basic knowledge of the DOS operating system. Also, note that while the user interface runs the core model for one specified set of conditions, it cannot run multiple runs in batch mode. Multiple runs can be performed by creating and running a batch file in DOS or in a DOS window in a Windows 3.1 or 95 environment.

The reporting utility, written using Microsoft's ACCESS database software, is used to create standardized reports using output data generated in the core model. Like the graphical user interface, the reporting utility is a fully operational Windows program, with pull-down menus, designed as a separate module in order to take advantage of the many reporting and formatting options available when using a database application. Although the reporting utility is written in ACCESS, it is a stand-alone application, and you do not need to know how to use ACCESS to generate reports.

**Figure 1-1. NONROAD MODEL FLOWCHART**



**GUI:** Visual Basic program used to easily modify core model input options file, launch the core model, and open the reporting utility.

**Core Model:** Fortran program which computes nonroad emissions. Reads numerous data files and writes ASCII output files.

**RU:** Microsoft ACCESS program with pull down menus to allow easy reporting of core model results.

The reporting utility provides the user with the following standard reports:

- Emissions Totals by County
- Emissions Totals by Equipment Type
- Emissions Totals by Horsepower
- Emissions Totals by SCC (source category code)
- Emissions Totals by Source Classification and Horsepower
- Emissions Totals by Source Classification
- Population and Fuel Consumption by SCC
- Population and Fuel Consumption by Source Classification and Horsepower

For most reports, emissions can be reported for either all counties or for a single, user-specified county and for all fuels or for a single user-specified fuel type. Reports that include emissions estimates by equipment types or by SCC are separated by major source classification (e.g., agricultural, lawn and garden), with subtotals provided for each classification. For those reports, equipment type descriptions are also included (e.g., “2-wheel tractors”, “asphalt pavers”, etc.). Where appropriate, reports also include a grand total by pollutant.

In addition to generating and viewing standardized reports from single model runs, the reporting utility provides the user the ability to compare the results of two separate model runs. The current version of the reporting utility has standardized reports for comparing two model runs by

- Emissions Totals by SCC,
- Emissions Totals by Source Classification,
- Emissions Totals by Horsepower and Source Classification, and
- Population and Fuel Consumption by SCC.

For the emissions totals comparisons, the report displays the results of the two model runs, and the absolute and percent difference between the two model runs. For the population and fuel comparisons, the report displays only the results of the two model runs side by side. The comparison reports are useful, for example, to compare emissions from present and future year projections, or to compare emissions with two different future year control programs.

### **Model Inputs**

The NONROAD model estimates emissions for each specific type of nonroad equipment by multiplying the following input data estimates:

- Equipment population for base year (or base year population grown to a future year), distributed by age, power, fuel type, and application;
- Average load factor expressed as average fraction of available power ;

- Available power in horsepower;
- Activity in hours of use per year; and
- Emission factor with deterioration and/or new standards.

The emissions are then temporally and geographically allocated using appropriate allocation factors.

There are several input files that provide necessary information to calculate and allocate emissions estimates. These input files correspond to the basic data needed to provide the calculations: emission factors, base year equipment population, activity, load factor, average lifetime, scrappage function, growth estimates, and geographic and temporal allocation. Default values are provided for all input files. The user can replace the default data files when better information becomes available, either from EPA for national defaults or from local sources for locality-specific data. The input files are also modifiable to test control strategies.

### **Output Options**

Output from the core model is an ASCII file, which can be imported directly into the reporting utility by simply specifying the file name. The reporting utility can then be used to generate the standardized reports; users with ACCESS can generate their own reports or query the emissions estimates and other output from the model. The ASCII file can also easily be imported into an Excel or Lotus spreadsheet for those users who prefer spreadsheet applications, or wish to generate graphs of model output. In addition, the reporting utility has a feature that allows users to easily output an Excel file of data in a tabulated report; Excel can then be used to graph the tabled results.

Lastly, the user also has the option to generate an Emission Pre-Processor System 2 (EPS-2) input file. EPS-2 is a program, available on EPA's Web site or bulletin board, that can take the county-level output from the NONROAD core model and create gridded emissions files ready for input to the Urban Airshed Model (UAM), a photochemical grid model.

## TECHNICAL DOCUMENTATION

Technical documentation of the default model inputs may be found at the EPA's Office of Mobile Sources (OMS) web site for nonroad modeling:

<http://www.epa.gov/otaq/nonrdmdl.htm>

The documents can be downloaded as either Adobe Acrobat PDF files or as WordPerfect files. If you obtained the model from a CD-ROM rather than downloading it from the web site, the technical documents are included on the CD-ROM.

As of the release date for this version of the model, the following technical documents are available:

- Weekday and Weekend Day Temporal Allocation of Activity in the NONROAD Model (NR-015)
- Geographic Allocation of State Level Nonroad Engine Population Data to the County Level (NR-014b)
- Emission Deterioration Factors For Spark-Ignition (NR-011a)
- Refueling Emissions for Nonroad Engine Modeling (NR-013a)
- Average Life, Annual Activity, and Load Factor Values (NR-005b)
- Nonroad Engine Population Estimates (NR-006b)
- Exhaust Emission Factors -- Compression-Ignition (NR-009b)
- Exhaust Emission Factors -- Spark-Ignition (NR-010c)
- Nonroad Engine Growth Estimates (NR-008b)
- Calculation of Age Distributions -- Growth and Scrappage (NR-007a)
- Basic Evaporative and Crankcase Emission Rates (NR-012a)
- Seasonal and Monthly Activity Allocation Fractions (NR-004)
- HC Conversion Factors: VOC/TOG/ROG/etc (NR-002)
- Exhaust Emission Effects of Fuel Sulfur and Oxygen on Gasoline Nonroad Engines (NR-003)
- RVP and Temperature Corrections (NR-001a)

Any additional technical documents will be posted on the web site when they are completed. Also currently available on the web site are numerous review documents, papers, and presentation materials.

For answers to specific questions on the NONROAD model and model inputs, or to make comments or suggestions, email the nonroad inventory model team at:

nonroad@epa.gov

## FUTURE MODEL UPDATES

December 2002

The EPA NONROAD modeling team is very interested in receiving comments on this version of the model and suggestions for future model revisions and enhancements. E-mail your comments and suggestions to the team at [nonroad@epa.gov](mailto:nonroad@epa.gov)

All updates to the model will be announced on and available from the OTAQ nonroad modeling web site.

## TO STAY INFORMED

For the latest news on the NONROAD inventory model, subscribe to EPA-MOBILENEWS. EPA will use this listserver as the primary means of communication on the NONROAD model to distribute technical memos for review, to answer commonly asked questions, and to announce future model updates. The list is also used for EPA's other mobile source inventory models, so if you use the MOBILE series of models, you may already be a subscriber.

To subscribe to the EPA-MOBILENEWS listserver, send the following message to the EPA Listserver address:

```
subscribe EPA-MOBILENEWS FIRSTNAME LASTNAME
```

where FIRSTNAME and LASTNAME is your name (for example: subscribe epa-mobilenews George Jetson). The listserver email address is:

```
listserver@unixmail.rtpnc.epa.gov
```

Your email address will then be added to the list of subscribers and a confirmation message will be sent to your email address. Whenever EPA posts a message to the listserver, a copy of that message will be sent to all subscribers.

## CONVENTIONS USED IN THE USER'S GUIDE

The following conventions are used in this User's Guide:

- “Click” when used in reference to commands means to carry out the command by clicking it with the left button on the mouse or using keyboard equivalents -- for example, the **Enter** key used in place of the **Enter** command.
- “Enter OK” means to click the **OK** button with the mouse or press the **Enter** key to carry out the action.

- A dialog box option is enabled when its button contains a black dot. The absence of a black dot means the option is disabled.
- Key strokes are printed in bold and bracketed. For example <**R**> means to press the R key on the keyboard.
- Carrying out commands or procedures with keys frequently involves pressing two or more keys together. For example, <**Alt-F**> means to hold down the **Alt** key while simultaneously pressing **F**.
- “Arrow keys” or “Cursor keys” are collective terms for the Up, Down, Left, and Right arrow keys.
- A selection from a windows menu bar is illustrated by **bold type** and the full name of the pull-down menu. For example, **Reports** from the Reporting Utility menu bar. To demonstrate the selection of an item in a pull-down menu both the main menu selection and the submenu selection are in bold type connected with a “►”. For example, **Reports ► Emission Totals by SCC**, indicates you should pull-down the Reports submenu and select the Emission Totals by SCC report.
- Files names are italicized. For example, the default option file provided with the NONROAD model is *template.opt*.

Both the Graphical User Interface and the Reporting Utility are standard WINDOWS applications. They use pull-down menus, dialog boxes, and message boxes. This document assumes that an individual setting up and running the NONROAD model has experience in a Windows environment. If you find yourself bogged down in either the graphical user interface or the reporting utility perhaps you would benefit from one of the many books available that discuss in great detail the windows environment.

A very brief summary of pull-down menus follows using the example **Reports ► Emission Totals by SCC** from the Reporting Utility:

You can activate the Reports submenu using the mouse or with keyboard strokes. With the mouse, you move the mouse pointer over Reports and click with the left mouse button. This displays the reports submenu list. To select an item from the pull-down list click on the item with the left mouse button. You can also click on the Reports menu and then drag the mouse to the item of interest (Emission Totals by SCC) while holding down the left mouse button. When you release the button the item is selected.

Alternatively, using the keyboard you can activate the Reports submenu by typing <Alt-R>, where R is the underlined character of the menu selection (usually the first character of the word if there are no conflicts). You can also use the arrow keys to move to a different menu selection or within the submenu list. To select a pull-down menu option type the underlined letter in the item name. For the above example, <S> will select the Emissions Totals by SCC report.

## ORGANIZATION OF THE USER'S GUIDE

To assist you in the set-up and operation of the nonroad emissions model, this document guides you in the process of installing the model, provides information on system requirements to operate the model, and provides detailed information on each component of the model. In addition, a chapter is provided to assist you on more advanced topics.

The user's guide is organized in the following manner:

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**Note:** For reference, each chapter begins with a "Quick Start" section that summarizes the steps explained in the chapter. The chapters then continue with a more detailed guide to the model. As the detailed descriptions include some important notes on the proper use of the model, we recommend that you read the chapters completely before using the model for any official purposes.

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**Chapter 2 - Getting Started:** This chapter provides information on model hardware and software requirements. In addition, instructions are provided on installing the model on the your computer.

**Chapter 3 - Graphical User Interface:** This chapter discusses the graphical user interface in detail, and how to specify and change model inputs for most model runs.

**Chapter 4 - The Core Model:** This chapter describes how to edit options using a text editor and how to run the core model. Step by step examples are provided.

**Chapter 5 - Reporting Utility:** This chapter describes the reporting utility and provides you with information on how to import data from a model run and generate standardized reports.

**Chapter 6 - Advanced Topics** - This chapter provides detailed information to assist more advanced users of the model. This detailed information includes:

- a description of the core model inputs;
- a description of required and optional input file packets;
- how to incorporate local data by editing input tables;
- how to perform additional model runs by editing input tables;
- a description of core model output options, such as the generation of EPS-2 input files and the creation of spreadsheet files; and
- how to model more advanced scenarios.

**Chapter 7 - Trouble Shooting** - This chapter describes possible solutions to troubles you may have running the model.

Several appendices are included that document FIPS and SCC codes used by the NONROAD model and provide examples of reporting utility standardized reports.

## Chapter 2

# Getting Started

In this chapter of the User's Guide, the following topics are discussed:

- the minimum system requirements for installing and running the model; and
- the steps involved in installing the NONROAD model on your computer.

### QUICK START

The process of installing the NONROAD model on your computer is quite simple; there is only one file required for installation, and it works for Windows 3.1, 95, 98, 2000, and NT. It is named *setup.exe*, and it is included on the NONROAD CD-ROM or can be downloaded from the nonroad modeling web site. In addition, the CD includes electronic copies of this NONROAD User's Guide, all currently available technical reports, and the source code for the FORTRAN core model.

In brief, the steps involved in installing and setting up the NONROAD model are as follows (in this example drive D is used for the CD drive and you should substitute the appropriate letter for the CD drive on your system):

1. Insert the NONROAD CD-ROM in drive D.

Windows 3.1: **File** ► **Run** and then type *d:\setup.exe*

Windows 95, 98, 2000, NT: **Start** ► **Run** and then type *d:\setup.exe*

2. The NONROAD model installation program will prompt you for information as required during the installation process. Once you have supplied the necessary information, the program will install the NONROAD model on your computer. When the process is complete, a message box will appear indicating that the installation was completed successfully.

### SYSTEM REQUIREMENTS FOR RUNNING THE NONROAD MODEL

The following are the minimum system requirements for running the NONROAD model:

- **Processor** 486
- **RAM** 8 megabytes
- **Drive** CD-ROM (or access by network)
- **Operating System** Windows 3.1, Windows 95, or Windows NT
- **Mouse**

It is recommended that you have at least 30 megabytes of free disk space for installation of the NONROAD model. The installation itself requires approximately 25 megabytes of disk space, and additional disk space is needed for the output files that are generated when running the model and for importing those output files into the reporting utility. The 25 megabytes of installed files consist of approximately 1 megabyte for the core model, 10 megabytes for the data files, 10 megabytes for the reporting utility, and 4 megabytes for the graphical user interface.

## INSTALLING THE NONROAD MODEL

To install the NONROAD model, follow these steps:

1. Insert the NONROAD CD-ROM in drive D (substitute the appropriate letter for the CD drive on your system).
2. Begin the installation procedure.  
Windows 3.1: Specify **File** ► **Run** and enter *d:\setup.exe*. Specify **OK**.  
Windows 95, 98, 2000, NT: Specify **Start** ► **Run** and enter *d:\setup.exe*.  
Specify **OK**.
3. During the installation process, a number of dialog screens will appear that request information from you to assist in installing and setting up the program. Once you have provided all required information, the installation program will set-up a directory on your computer and copy the necessary files to that directory.
4. The installation program will create a program group on your computer called Nonroad. This program group will contain icons for four components of the model -- the graphical user interface, the core model, the reporting utility, and the compact utility. For information on the operation of each of these components, see Chapter 3 (graphical user interface), Chapter 4 (core model), and Chapter 5 (reporting and compact utilities).

### Attaching the Reporting Utility Databases

When the NONROAD model is installed, a subdirectory called Reports is created. Within this subdirectory are two databases, *Nrdata.mdb* and *Reports.mdb*, required to run the reporting utility. To operate the reporting utility, *Reports.mdb* must have the path of *NRdata.mdb* in order to properly connect to it. This connection is done automatically the first time the Reporting Utility is opened.

If the Reporting Utility cannot find *Nrdata.mdb* (for example, the file was moved to another directory) then a message is displayed. You must attach the tables in order to successfully

*December 2002*

generate reports. Refer to the section in Chapter 5 titled Attaching the Reporting Utility Databases.

## **REINSTALLING THE NONROAD MODEL**

The NONROAD model can be completely reinstalled on your computer by following the steps outlined above. During reinstallation, the program will search for a current installation of the program. If any current NONROAD files are found, the program will ask you whether you want to overwrite the files. Indicate **Yes** or **No**.

## Chapter 3

# Graphical User Interface

In this chapter of the user's guide, the following topics are discussed after the Quick Start description:

- a general description of the graphical user interface,
- moving around in the user interface,
- creating an option file and specifying model parameters,
- running and viewing a model scenario, and
- some advanced options.

### QUICK START

The process of setting up an option file that contains a scenario that you are interested in modeling, and running and viewing the modeling results, is quite simple with the graphical user interface. Each of the steps involved is discussed in detail in this chapter. In summary, the steps involved in setting up, running, and viewing a modeling scenario are as follows:

1. Start the Graphical User Interface using the icon created when the EPA NONROAD Emissions Model was installed on your computer. (For more information, see General Description below.)
2. Define the parameters that you are interested in modeling. When you first run the interface, the modeling parameters are contained in the default option file *TEMPLATE.OPT* which is automatically read by the interface. Select **Scenario** on the main menu. A submenu will appear that contains the various options that you can specify. These options include the title of your model run, fuel specifications, the period of time and geographical region over which you want to estimate emissions, and the source categories that you want to model. (For more information, see the section below on Creating an Option File.)
3. Save the modified option file, **File** ► **Save** (or **Save As**). (For more information, see the section below on Creating an Option File.)
4. Submit your option file to the core model to run, **Model** ► **Run**. Once the run has been completed, a message will appear in a DOS screen notifying you that the run

was successful. (For more information, see the section below on Running and Viewing a Modeling Scenario.)

5. To view the results of this model run, specify **Model ► Reports**. This will move you to the reporting utility. (For more information, see the section below on Running and Viewing a Modeling Scenario.)
6. Exit the interface when you are finished with **File ► Exit**. (For more information, see the section below Exiting the Graphical User Interface.)

## GENERAL DESCRIPTION

The NONROAD user interface provides you with an easy method for designing the nonroad emissions simulations that you are interested in modeling. In addition, the interface provides you with an easy means for accessing the reporting utility to view the results of your modeling run. With simple Windows-type screens and pull-down menus, you can quickly set up, execute, and view a modeling scenario without any computer programming experience.

When the NONROAD emissions model is installed on your computer, an icon for each component of the model is created. While this allows you to access each component of the model individually, through the interface you can operate most of the functions of the EPA NONROAD Emissions Model -- from the creation of a scenario, to the running of the core model, to the development of reports -- without exiting one program and executing another.

**Note:** In this chapter of the user's guide, information is provided to assist you in setting up an emissions scenario to model using the default data provided in the model. If you are interested in modifying the data files to reflect alternatives to the default data, please see Chapter 6 on Advanced Topics.

## MOVING AROUND IN THE GRAPHICAL USER INTERFACE

Begin the Graphical User Interface denoted by the icon displayed in Figure 3-1. If your computer operates with Windows 95, the icon can be found in a program group called **Nonroad Model** accessed from the **Start** menu. If you are operating with Windows 3.1, the icon can be found through Program Manager.



Figure 3-1:  
Graphical User  
Interface icon.

When launched, the main menu screen of the interface appears (Figure 3-2). The title bar of the screen displays the NONROAD name followed by the currently opened option file in parentheses. The default is (*template.opt*). Below the title bar is the main menu bar, followed by the EPA banner, and the model run title, message file name, and output file name which are extracted from the opened option file.

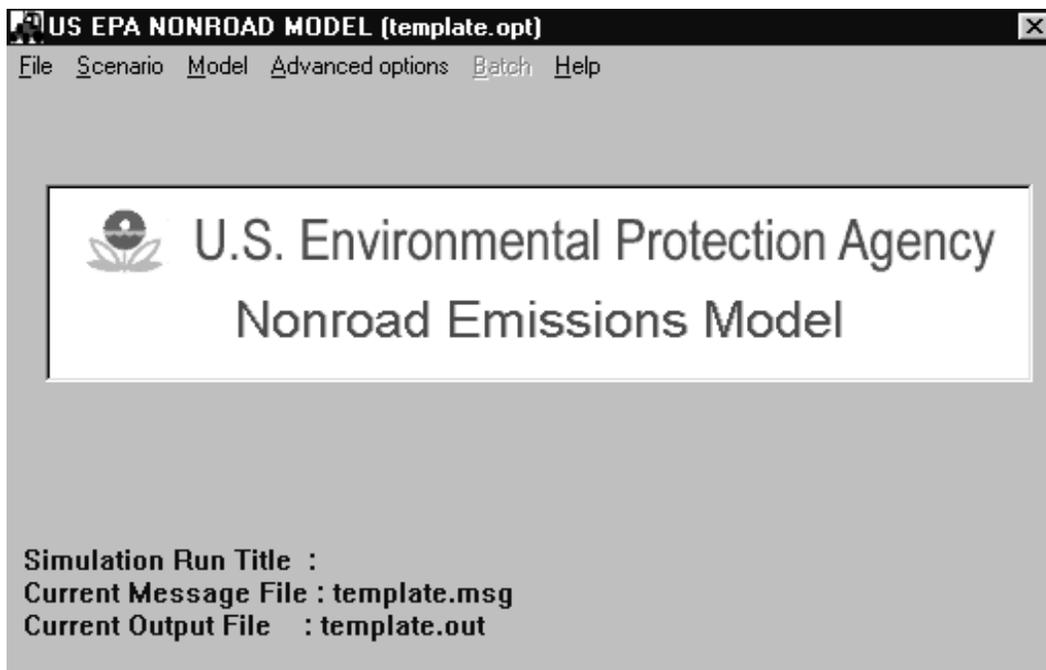


Figure 3-2: Initial graphical user interface screen.

From this screen you can access submenus that make up the graphical interface module, as listed at the top of the window in the menu bar:

- **File** - open an existing option file, save a modified option file with the old or a new name, or exit the interface.

- **Scenario** - define the various parameters that you want in your modeling run.
- **Model** - run the core model and access the reporting utility.
- **Advanced Options** - select your own data files to replace the default files provided with the model and to specify optional output.
- **Batch** - this option is unavailable. Multiple runs must be done manually.
- **Help** - general information is provided on the version and status of the model.

Once a main menu item is selected, a list of submenu items will be displayed. The following shows the list of submenu items for each of the main menu choices:

|                          |   |
|--------------------------|---|
| <u>F</u> ile             | <u>O</u> pen<br><u>S</u> ave<br>Save <u>A</u> s<br><u>E</u> xit   |
| <u>S</u> cenario         | <u>O</u> ptions<br><u>P</u> eriod<br><u>R</u> egion<br><u>S</u> ources  |
| <u>M</u> odel            | <u>R</u> un<br><u>R</u> eports  |
| <u>A</u> dvanced Options | Geographical <u>A</u> llocation<br><u>T</u> emporal Allocation<br><u>G</u> rowth<br><u>E</u> quip. Population<br><u>P</u> hase In<br>Emission <u>F</u> actors<br><u>D</u> eterioration Factors<br><u>A</u> ctivity<br><u>O</u> ptional Output |
| <u>H</u> elp             | <u>H</u> elp<br><u>A</u> bout<br><u>C</u> urrent  |

In most instances, after selecting a submenu item a form is displayed for user inputs or selections. When an input error occurs, an appropriate message (dialog box) is displayed. If a dialog box appears, specify **OK**, make the corrections needed and continue.

## CREATING AN OPTION FILE

The first step involved in operating the EPA NONROAD Emissions Model is to setup an option file which defines the parameters that you are interested in modeling. Once this file has been set up, it can be submitted directly to the core model from the interface, and then following the model run the estimated emissions output can be imported into the reporting utility and standard reports generated.

An option file (\*.opt) contains all of the parameters that specify your modeling run. This file is opened, read, and updated from the interface. To more easily explain the process of setting up an option file, the following example is provided:

*You have been given an assignment to estimate the total emissions from all lawn and garden equipment in Travis County (Austin), Texas. You are interested in estimating these emissions for the summertime of 1998.*

Throughout this chapter, we will refer to the above example.

### Opening and Naming an Option File

When you first run the interface, the default option file *TEMPLATE.OPT* is automatically opened and the file name is displayed on the title bar of the main screen. Also displayed in the main menu screen is the run title, the message file name, and the output file name extracted from the currently opened option file. You can modify the default option file to define a modeling scenario of interest. Alternatively, if you want to use or modify a different option file (\*.opt) that you have previously created, follow these steps:

1. From the Main Menu, select **File** ► **Open**.
2. An open file dialog box appears that requests you to select a new option file. Specify the option file you are interested in using. This loads the option file into the interface and updates the main screen.

Before beginning to modify the scenario options in the option file, you should save the option file with a different name to prevent yourself from accidentally overwriting data in a previously created option file or in *TEMPLATE.OPT*. To do this, select **File** ► **Save As** and indicate the new file name. For our example, you would specify the file *TRAVIS.OPT*. The main menu screen title bar is updated with the new file name. In addition, when you specify a new file name the message file and output file names are set to the same name as the specified option file with

the file name extensions *.msg* and *.out* respectively. For our example, you see the files *TRAVIS.MSG* and *TRAVIS.OUT*.

**Note:** The name of the option file must be no longer than eight characters as a result of DOS conventions. It is recommended that the extension *.OPT* be used for all option files.

If the message file specified in the opened option file exists then the button “View Message File” will appear in the middle of the main menu window. Click on this button to open Windows Notepad and review the indicated message file.

### Defining a Report Title

The interface allows you to easily title your model run. This title will be used on any reports you might generate for this particular scenario.

To provide a descriptive title for your model run, follow these steps:

1. From the main menu select **Scenario ► Options**.
2. Update the Options screen (Figure 3-3). When the Options screen first appears, it will contain the title and any options previously defined for this option file. Specify a descriptive title for your scenario in the field below Title 1. If you want to add a subtitle, you can do so in the field below Title 2.
3. Specify **Done** or **OK** to return to the main menu.

**Note:** The two title lines of your modeling run must be no longer than 80 characters each. In addition, the titles should not include single or double quotation marks (i.e., “ or ’), or periods.

Figure 3-3: Options screen.

### Defining Fuel Specifications, Ambient Temperatures, and Stage II Control Effectiveness

Nonroad emissions result from the combustion, evaporation, and spillage of fuel in equipment and vehicles designed primarily for off-road use. The emissions that come from nonroad equipment and vehicles are dependent, in part, on the composition of the fuel used. Similarly, the ambient temperature will also affect the emissions from nonroad sources. Finally, implemented controls act to decrease emissions. As a result, it is important to define the composition of the fuel, the ambient temperature for the period of time that you are interested in modeling, and the effectiveness of any existing controls.

The minimum temperature that you define for your modeling scenario is the average low for the time period selected. For example, when modeling a typical summer day, the minimum temperature should be the average low temperature in Fahrenheit for the summer season. Moreover, when modeling an entire year, the minimum temperature should be the average daily low for the year and not the lowest temperature ever recorded. Other modeling parameters, such as RVP, sulfur, and oxygen content, depend on local fuel characteristics. Data for an area should be available from the state or local air agency.

Stage II controls are designed to reduce emissions during refueling due to vapor displacement. They are generally mounted on the pumps at gasoline stations. With regards to nonroad

equipment, their benefits only apply to equipment that are refueled directly via the pumps (rather than with refuel tanks). Where present, the effectiveness of this control is also affected by the design of the filler opening of the equipment.

**Note:** EPA currently has no data on the effectiveness of Stage II for nonroad equipment. The value should be left at 0% unless local data exist on which a value can be based.

To specify fuel characteristics, temperature, and Stage II control effectiveness, follow these steps:

1. From the main menu select **Scenario** ► **Options**.
2. Modify the required parameters. For our example, indicate the gasoline specifications and ambient temperatures that will be in effect in Travis County during the summer of 1998. Next, identify whether the modeling region is at high or low altitude<sup>2</sup>. High should be specified where the average altitude is greater than 5000 feet; this is consistent with the MOBILE program.
3. Specify **Done** or **OK** to return to the main menu.

The acceptable range of values for each of the fuel specification and ambient temperature options are as follows:

| Parameter                          | Minimum | Maximum |
|------------------------------------|---------|---------|
| Fuel RVP (psi)                     | 6       | 16      |
| Oxygen (wt.%)                      | 0       | 5       |
| Fuel Sulfur (wt %)                 | 0       | 0.5     |
| Temperature (F)                    | -40     | 120     |
| Stage II control effectiveness (%) | 0       | 100     |

**Note:** The percent effectiveness value must be followed by a decimal point.

---

<sup>2</sup> Altitude adjustment is not in this version of the model. Hence, this selection is currently disabled in the user interface.

## Defining the Modeling Period

The modeling period is simply the period of time for which you want to estimate emissions. To define the modeling period, follow these steps:

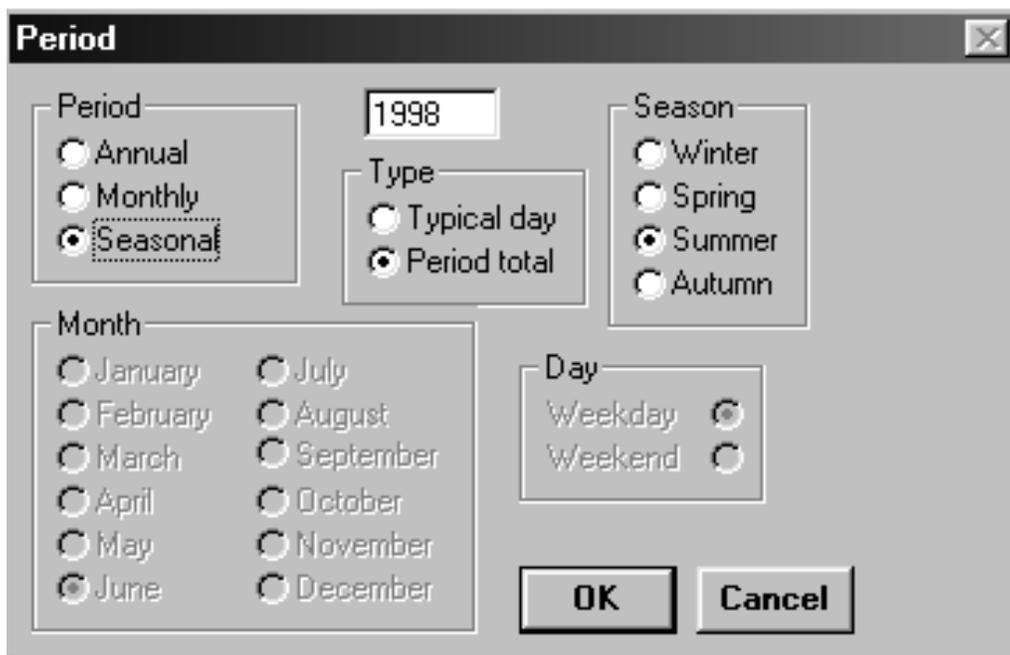


Figure 3-4: Period screen.

1. From the main menu select **Scenario** ► **Period**.
2. Indicate the modeling period of interest in the displayed screen (Figure 3-4).

The interface makes it easy to define the modeling period through a series of select buttons. The following options are available to you:

- **Year** - You can define any year between 1970 and 2050 that you are interested in modeling.
- **Period** - You can define the modeling period as annual, monthly, or seasonal.
- **Month** - If you select the modeling period to be monthly, the list of months will become active and you can select the appropriate month of the year.

- **Season** - If you select the modeling period to be seasonal, the list of seasons will become active and you can select the appropriate season of the year.
- **Type** - For any period that you select, you can estimate the emissions as the total for a 24-hour period (typical day) or for the total period.
- **Day** - If you select the type to be a typical day, days will become active and you can select a weekday or weekend day.

**Note:** While the model allows you to define any model year from 1970 to 2050, it actually forecasts and backcasts based primarily on 1998 data. For this reason, its estimates become less accurate as you move further into the past or the future.

Since we are interested in estimating the total emissions during the summertime of 1998 in our example specify **Seasonal** (under Period), **Summer** (under Season), **Period Total** (under Type), and type in 1998 in the year field.

3. Specify **Done** or **OK** to return to the main menu.

### Defining the Modeling Region

The interface makes it relatively easy to define the geographical region -- from one county to multiple counties to an entire state or the nation -- that you are interested in modeling. To do this, follow these steps:

1. Specify **Scenario** ► **Region**. The Region screen will appear (Figure 3-5).
2. The first step in defining the modeling region is to remove any regions that have been specified in a previous scenario that are not applicable to the current scenario. To do this, highlight the regions in the Current selection list and click on **Del**.

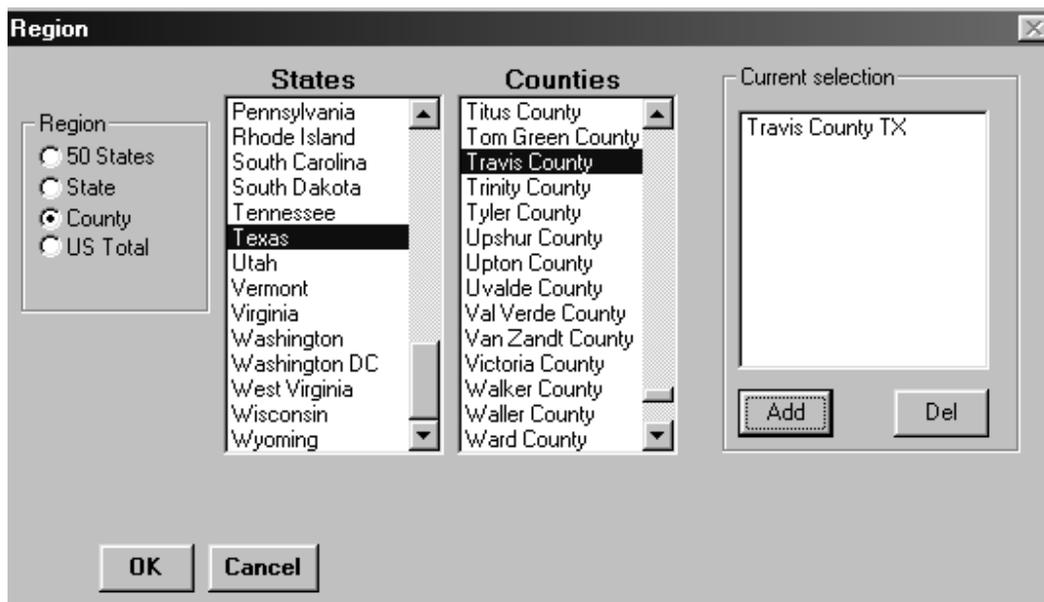


Figure 3-5: Region screen.

3. Specify a region. Several options are available, the methods for selecting them are as follows:
  - **50 States** - This option selects all 50 states, you will obtain the state totals for all 50 states individually. When selected, the “Current selection” list is cleared, as no individual states or counties need be specified.

**Tip:** Since selecting 50 States as a region clears the current selection list this is a quick and easy way to delete all of specified states or counties before starting a new region definition.

- **State** - This option allows you to select any one, or multiple, of the 50 states. When a state is selected, the model will compute total emissions for the entire state, but will not allocate emissions among counties in the state. Specify **State** (under region), scroll through the list of states or type the first letter to jump in the list. Once found, highlight the state and then **Add**. The state will appear in the current selection field.
- **County** - This option allows you to select one or more counties. To select an individual county, specify County (under region) and highlight the state of interest. When you highlight the state a list of counties for that state will be displayed. Move through the list of counties until you find the one that you want,

highlight the county, and then **Add**. The county name and state abbreviation are written to the Current selection list.

To specify all counties within a state, indicate **County** (under region), highlight the state of interest, and then **Add**. The Current selection list will display the state name (e.g., Michigan) with “All of ...” (e.g., “All of Michigan”). The core model will compute emission estimates for all of the counties in the named state.

**Note:** To create a modeling region that is larger than a single state or county, continue to add new regions to the list of currently selected regions by repeating the process for selecting states or counties. For example, if a metropolitan area covered four counties, simply select the first county and then each additional county one at a time.

- **US Total** - This option allows you to estimate national total emissions, no state detail is generated. When selected, the “Current selection” list is cleared, as no individual states or counties need be specified.

**Note:** The NONROAD model also allows you to define a sub-county region. However, this option requires that you provide a significant amount of data beyond that furnished with the model. For information on how to input this additional data, please see Chapter 6, Advanced Topics.

For our example scenario, indicate **County** (under Region), highlight Texas from the list of states, highlight Travis from the list of counties, and **Add**.

5. Specify **Done** or **OK** to return to the main menu.

## Defining Source Categories

The EPA NONROAD Emissions Model allows you to estimate emissions from many different types of equipment and vehicles. Each source category in the NONROAD model is uniquely identified with a source category code (SCC), which is a ten-digit number. The first two digits, 22, represent mobile sources. For most categories, the next two digits represent the engine or fuel type (60, 65, 67, 68, and 70, represent 2-stroke gasoline, 4-stroke gasoline, LPG, CNG, and diesel respectively). The next three digits represent the segment type (for example, recreational or construction). And the last three digits represent the kind of equipment (for example, golf carts or snowmobiles). Refer to Appendix B for a complete list of NONROAD SCCs.

When selecting source categories to process in a NONROAD simulation you can specify ‘global’ source category codes instead of each individual SCC. For example, instead of listing all lawn

and garden equipment types individually, when you specify **Add segment** the SCCs are listed with the last three digits (equipment type) as zero. It is implied that all equipment types will be processed.

To define the source categories that you want to model, follow these steps:

1. From the main menu specify **Scenario** ► **Sources**. The Sources screen will appear (Figure 3-6).

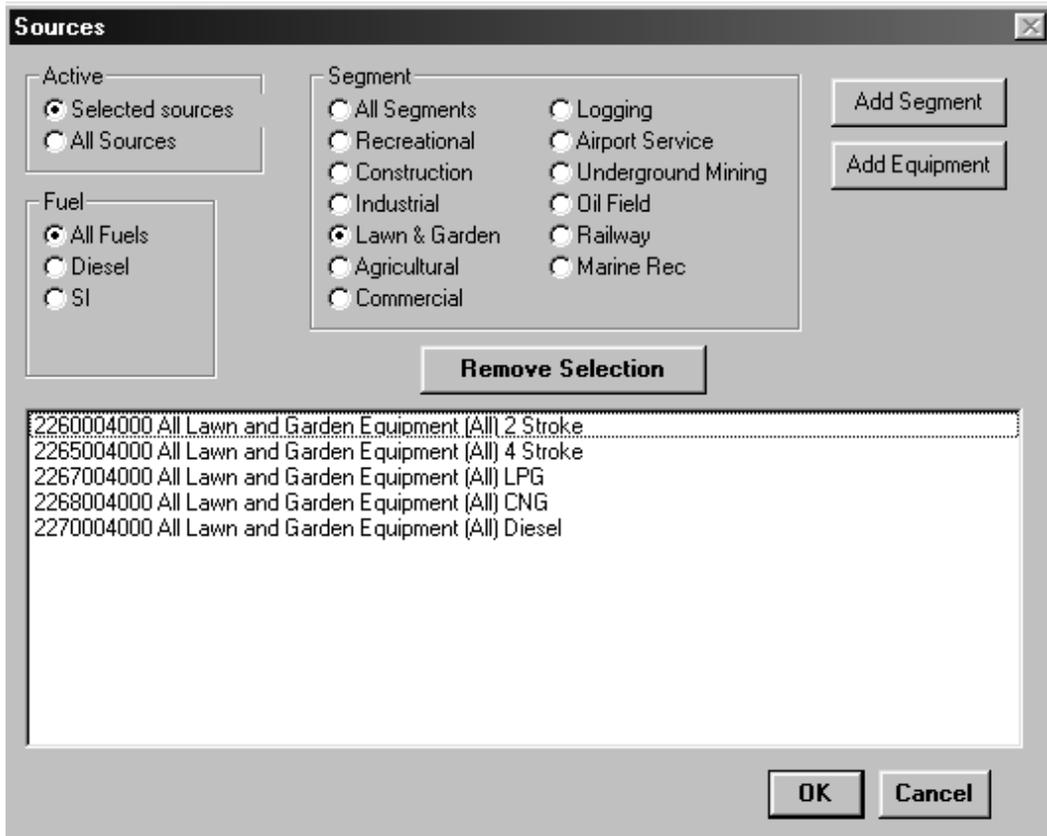


Figure 3-6: Sources screen.

The following options are available:

- **Active** - Choose either 'Selected sources' to specify a subset of sources to model or 'All Sources' which will model all SCCs with valid equipment population data. If 'All Sources' is selected then the ability to select specific SCCs is removed (i.e. the Add buttons become deactivated).
  - **Fuel** - Choose between 'All Fuels', 'Diesel', or 'SI' (spark ignition engines).
  - **Segment** - Choose one of the segments listed.
  - **List of selected sources** - Each selected SCC and a brief description is displayed in the lower portion of the window.
  - **Add Segment** - The SCCs which represent the specified segment and fuel type will be added to the list of selected SCCs.
  - **Add Equipment** - The SCCs which represent the specified equipment within a segment will be added to the list of selected SCCs.
  - **OK** - Return to the main menu.
  - **Remove Selection** - This will remove any highlighted SCCs from the list of selected sources.
2. Similar to defining a region, you must first remove any source segments or equipment that you do not want to model. Highlight the segments and/or equipment in the list of selected sources and specify **Remove Selection**. Multiple sources may be highlighted by using the <Shift> or <Control> keys. The <Delete> key may also be used to remove the highlighted sources from the list of selected sources.
  3. Select the fuel type. For our example scenario we are interested in all lawn and garden equipment so we will specify **All fuels**.
  4. Select the segment type. For our example, we are interested in all lawn and garden equipment and select **Lawn & Garden**.

5. Specify **Add Segment** to add a list of SCCs for the specified segment/fuel to the current list of selected sources. Alternatively, if you are interested in specific equipment within a source segment then **Add Equipment**. All of the equipment that falls under the specified segment/fuel type will appear in the list of selected sources. Highlight the equipment that you do not want to model and remove them from the selection list (see 2 above).

**Note:** If you are interested in estimating emissions from more than one segment or fuel type, add the first segment/fuel type and then continue adding segment/fuel types as desired.

6. When you have finished defining sources, specify **OK** to return to the main menu.

### **Saving an Option File**

Once you have created an option file by defining all of the parameters that you want, you should save this file. To do this, follow these steps:

1. From the main menu **File** ► **Save**.

## **RUNNING AND VIEWING A MODELING SCENARIO**

Once you have set up an option file, the interface allows you to easily submit the option file to the core model to run. Similarly, the interface allows you to access the reporting utility to view the results of your run and prepare printed reports.

To submit an option file to the core model, follow these steps:

1. From the Main Menu, specify **File** ► **Open**.
2. Specify the option file you want to model in the open file dialog box. This loads the option file into the interface and the file name is displayed on the main menu title bar. If the option file is already loaded, you can skip steps 1 and 2.
3. From the main menu, specify **Model** ► **Run** (Figure 3-7).
4. A DOS window will appear. After the run has been completed, a message will appear notifying you that the run was successful.

If the DOS window disappears after the core model completes and you wish to view the DOS screen, then you need to change the default 'close on exit' in your Windows

application. If you are running Windows 3.1, this can be accomplished by using the PIF Editor (from Windows Main group) to edit the *NONROAD.PIF* file and disable the 'Close Window on Exit' box. If you are running Windows NT or Windows 95 and later versions, right click on the *nonroad.exe* file name, select Properties, select the Program tab, and disable the 'Close on exit' box. You will then need to manually close the DOS window when the core model completes.

5. To return to the interface, press <Enter>.

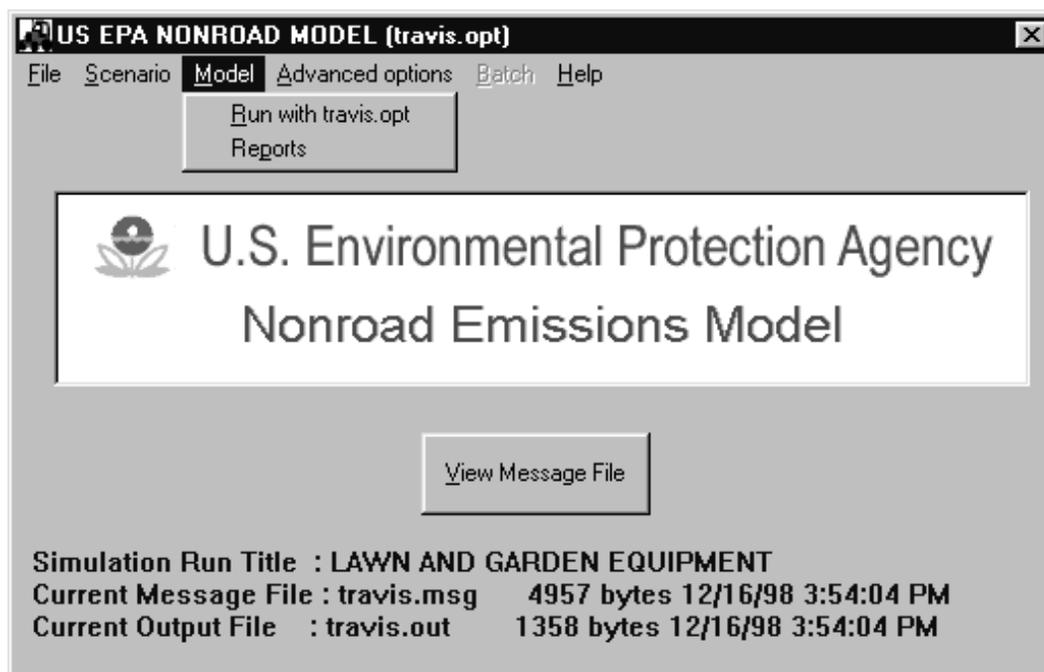


Figure 3-7: Model submenu screen.

6. It is important to review the output message file produced by the core model. In addition to any warning or error messages that are generated during execution the message file will indicate all of the parameters specified in the option file and all of the input files used in processing. These should be reviewed in order to verify that the simulation performed was what you intended. Specify **View Message File** from the main menu in order to open Windows Notepad and examine the message file.
7. If you are interested in modeling several scenarios prior to viewing and printing a report, repeat the above steps for each of your option files.

**Note:** The core model runs in DOS under a windows environment which allows you to multitask activities while the model is running. However, multitasking may lengthen the amount of time it takes for the model to run, particularly if you are using a 486 computer with less than 16 megabytes of RAM. If this describes your computer, you should consider closing all other applications prior to running the model.

To access the reporting utility, follow these steps:

1. From the main menu, specify **Model** ► **Report**. Refer to Chapter 5 for a complete description of the Reporting Utility.

## ADVANCED OPTIONS

The Advanced Options menu allows you to specify your own data files to replace the default files provided with the NONROAD model and to specify alternate output file formats. Each submenu selection allows you to specify a different file to use. In some cases, more than one file may be applicable to a selection.

Optional outputs include emissions files in either Emissions Processor System (EPS) AMS or National Emissions Trend (NET) format. (The latter format is currently unavailable.) These outputs are generated only if a filename is provided for the desired format.

If your modeling region is outside the state you specified during the NONROAD model installation then the default Geographic Allocation and Equipment Population file names will have to be changed. These files have been provided by state to reduce the size of the files.

## EXAMPLE OF CHANGING GEOGRAPHIC ALLOCATION

The Geographic Allocation selection allows you to identify the allocation look-up table (the default is “*allocate.xrf*”) and allocation data files that you want to use. The allocation look-up table is an assignment of equipment type to an allocation indicator (e.g., construction equipment assigned to employees in the construction industry). The allocation files contain the actual estimates of indicator values (e.g., the actual number of employees in the construction industry by county and year).

To change the look-up table or allocation data files, follow these steps:

1. From the main menu, select **Advanced options** ► **Geographic Allocation**. The Geographic Allocation screen is displayed (Figure 3-8).

2. The first step in defining the geographic allocation data files is to remove any previous data files. Highlight the current files and **Delete** one at a time.
3. Click **Add** to specify a new list of allocation files. An open file dialog box appears that requests you to select a new allocation file. Locate the directory where the allocation files are saved (when installed: \nonroad\data\allocate) and specify the data file that you want. Repeat this until all necessary files have been added.

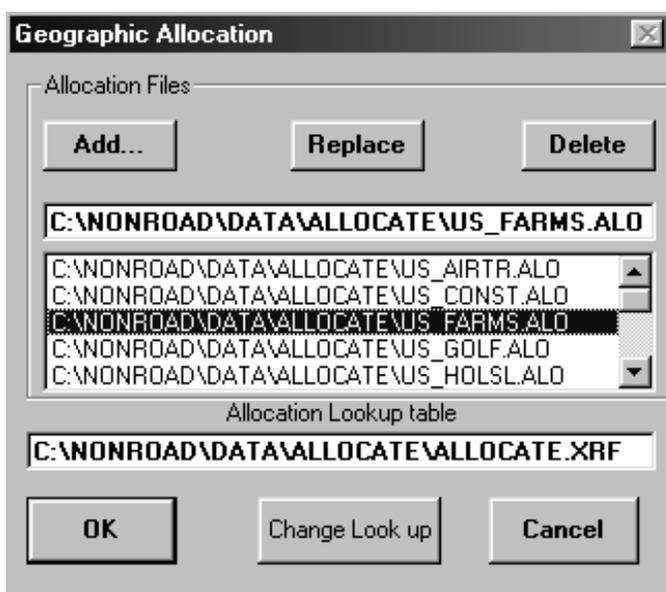


Figure 3-8: Geographic Allocation screen.

4. To change a specific allocation file, select that file from the list. Then enter the path and name of the new file in the text box directly above the list. Click **Replace**.
5. Specify **Change Look up** to change the allocation look-up table. Again, an open file dialog box appears that requests you to select a new allocation file (this time with the extension *.xrf*). Locate the directory where the allocation files are saved and specify the data file that you want.
6. Specify **Done** or **OK** to return to the main menu.

*December 2002*

## **EXITING THE GRAPHICAL USER INTERFACE**

To exit the interface, follow these steps:

1. From the main menu, specify **File ► Quit**.

## Chapter 4

# Core Model

In this chapter of the user's guide, the following topics are discussed:

- a general description of the core model,
- the process of modifying an option file and
- running the core model.

### QUICK START

The process of modifying an option file and running the core model using data provided in the NONROAD model is straightforward. In summary, the steps involved in running the core model with existing data are as follows:

1. Modify the core model input option file. To modify an option file, either use the graphical user interface as discussed in Chapter 3 or a text editor, such as Microsoft's Notepad or WordPad, to access the \*.opt file that you are interested in changing. Alternatively, you can edit the file through DOS. (For more information, see the section below on Creating an Option File.)
2. Once you have an option file defining the scenario that you are interested in modeling, you can run the scenario from the graphical user interface as discussed in Chapter 3, or from DOS by typing "*nonroad (the name of your option file).opt*" from the nonroad directory. (For more information, see the section below on Running the Core Model.)
3. After the model has finished, a message will appear in a DOS window notifying you of the successful completion of the run or of any errors that have occurred.

## GENERAL DESCRIPTION

The core NONROAD model contains all of the algorithms used by the model for calculating emissions estimates. The model includes standard data files and tables that allow you to easily estimate the emissions from a wide variety of nonroad equipment and vehicles for any region of the country. The information used by the core model for estimating emissions, including user-specified options, data files, and data tables, are input through an option file.

The core model can be operated as a stand-alone application; however, as a stand-alone application it requires some basic knowledge of the DOS operating system. In addition, in order to create/modify an input option file you must be familiar with the use of a text editor. If you prefer you can easily modify the input option file and access the core model from the GUI (Graphical User Interface), which is described in detail in Chapter 3.

When the NONROAD model is installed on your computer, a directory for the model is created. The standard installation creates the NONROAD directory on the c drive; i.e. c:\Nonroad. The core model is executed with the file *NONROAD.EXE*.

**Note:** In this chapter of the user's guide, information is provided to assist you in setting up an emissions scenario and running the model using the default data provided in the model. If you are interested in modifying the data files to reflect alternatives to the default data, please see Chapter 6 on Advanced Topics.

For more technical information on the core model, please refer to the technical support documents, or the core model source code.

## CREATING AN OPTION FILE

Before running the core model, you must define the scenario you are interested in modeling by creating an option file. All model input files and scenario specific parameters are specified in the input option file. The information contained in each option file is separated into "packets" based on common information. For example, all data items related to the period of time for which you are interested in estimating emissions is grouped in a single packet, as are data files related to the population of equipment for a modeling region. You can quickly set up an option file specifying the parameters that are applicable to your modeling scenario using default data.

You can view and modify an option file using a text editor such as Microsoft's Notepad or WordPad or by using the DOS command *edit*. When viewing an option file through a text editor, the keyword that identifies a packet is surrounded by forward slashes ("/") and can appear in upper case, lower case, or mixed case. For example, the packet identifier for all of the data files

related to the population of equipment is /POP FILES/. To designate the end, or terminator, of a packet, the keyword END is used, also surrounded by forward slashes (i.e., /END/).

One convenient aspect resulting from the use of a packet input structure is that packets can appear in any order in an option file. Furthermore, any type of notes or descriptions that aid in describing the packet can be placed between the individual packets. When executed, the core model searches for packet identifiers and reads the data between the identifier and the packet terminator. All other lines in the file are ignored. The file *TEMPLATE.OPT* is provided with the NONROAD model and contains a complete description of the packet parameters and formats.

In a fashion similar to that followed in Chapter 3, the following example is provided to more easily explain the process of creating and setting up an option file:

*You have been given an assignment to estimate the total emissions from all lawn and garden equipment in Travis County (Austin), Texas. You are interested in estimating these emissions for the summertime of 1998.*

This example will be referred to throughout this chapter.

To create an option file using a text editor, follow these steps:

1. Start the text editor of your choice. Notepad and WordPad are possibilities.  
**Note:** The use of a word processor such as WordPerfect or Microsoft Word is not recommended unless you are experienced in dealing with ASCII files in those applications.
2. Open the option file of interest.  
**Note:** If this is the first option file that you are creating, use *TEMPLATE.OPT*. The *template.opt* file, installed with the model, is initially located in the \nonroad directory. If you have previously created an option file, you can select any \*.opt file for modification.
3. Save the opened option file with a new name in order to prevent the accidental loss of data resulting from overwriting an existing file. For our example, save *template.opt* file as *travis.opt*. Figure 4-1 shows a portion of the file *template.opt*.

```
This is the options file for the NONROAD program.
The data is separated into "packets" based on common
information. Each packet is specified by an
identifier and a terminator. Any notes or descriptions
can be placed between the data packets.

-----

                          PERIOD PACKET

This is the packet that defines the period for
which emissions are to be estimated. The order of the
records matter. The selection of certain parameters
will cause some of the record that follow to be ignored.
The order of the records is as follows:

1 - Char 10 - Period type for this simulation.
                Valid responses are: ANNUAL, SEASONAL, and MONTHLY
2 - Char 10 - Type of inventory produced.
                Valid responses are: TYPICAL DAY and PERIOD TOTAL
3 - Integer - year of episode (4 digit year)
4 - Char 10 - Month of episode (use complete name of month)
5 - Char 10 - Type of day
                Valid responses are: WEEKDAY and WEEKEND

-----

/PERIOD/
Period type      : Annual
Summation type  : Period Total
Year of episode  : 1996
Season of year   :
Month of year    :
Weekday or weekend :
/END/
```

Figure 4-1: Portion of the *TEMPLATE.OPT* file.

4. Modify the option file. For our modeling example, we want to modify *travis.opt* by specifying the parameters required to estimate summertime emissions in 1998 from lawn and garden engines in Travis County, Texas.

For a simple modeling run, using the data provided with the model, five packets of information will most frequently be modified. These five packets are the */RUNFILES/*, */OPTIONS/*, */PERIOD/*, */REGION/*, and */SOURCE CATEGORY/* packets which are described in the following sections. In addition, the */POP FILES/* and */ALLOC FILES/* packets will be modified if the region is changed to another state.

### **Modifying */RUNFILES/***

In the */RUNFILES/* packet, some of the data files read by the model are defined. The first 20 characters of each line contains the keyword(s) which identify the kind of file specified. For our simple example, we are only interested in changing the name of the message file and the output data file. In Figure 4-2, the message and output data files have been changed (*travis.\**).

```
This is the packet that lists the names of output files
and some of the input data files read by the model.  If
a drive:\path\ is not given, the location of the
NONROAD.EXE file itself is assumed.  You will probably
want to change the names of the Output and Message files
to match that of the OPTion file, e.g., MICH-97.OPT,
MICH-97.OUT, MICH-97.MSG, and if used MICH-97.AMS.
-----
/RUNFILES/
ALLOC XREF      : c:\nonroad\data\allocate\allocate.xrf
ACTIVITY       : c:\nonroad\data\activity\activity.dat
TECHNOLOGY     : c:\nonroad\data\tech\tech.dat
SEASONALITY    : c:\nonroad\data\season\season.dat
REGIONS        : c:\nonroad\data\season\season.dat
MESSAGE        : travis.msg
OUTPUT DATA   : travis.out
EPS2 AMS       :
/END
```

Figure 4-2: *TRAVIS.OPT* /RUNFILES/ packet.

Note: The core model creates two output files. The first is a message file (\*.msg) that can be read with a text editor or through DOS and identifies relevant information on the model run such as time and date of the run, files processed, and any error or warnings which occurred during the run. The second is a data file (\*.out) that can be opened and viewed in the reporting utility.

To do this, follow these steps:

1. Locate the /RUNFILES/ packet in *travis.opt*.
2. Move to the “*Message file*”. Type in the name that you want to call the new message file (in our example *travis.msg*).
3. Move to the “*Output data file*”. Type in the name that you want to call the new output file (in our example, *travis.out*).

### Modifying /OPTIONS/

The options packet, /OPTIONS/, defines some of the parameters that make episode-specific emission factor adjustments. These options include fuel specifications that will be in effect during the modeling period and ambient temperatures that are typical during the same period. In addition, you can define the title that describes your modeling scenario and which will appear on your model reports.

The order of the records is fixed. The order is as follows:

- 1 - Char 80: First title on reports
- 2 - Char 80: Second title on reports
- 3 - Real 10: Fuel RVP of gasoline for this simulation
- 4 - Real 10: Oxygen weight percent of gasoline for simulation
- 5 - Real 10: Percent sulfur for gasoline
- 6 - Real 10: Percent sulfur for diesel
- 7 - Real 10: Percent sulfur for LPG/CNG
- 8 - Real 10: Minimum daily temperature (deg. F)
- 9 - Real 10: Maximum daily temperature (deg. F)
- 10 - Real 10: Representative average daily temperature (deg. F)
- 11 - Char 10: Flag to determine if region is high altitude (LOW or HIGH)

The acceptable range of values for each of the fuel specification and ambient temperature options are as follows:

|                  |             |   |
|------------------|-------------|---|
| Fuel RVP         | 6 to 16     |   |
| Oxygen (wt.%)    | 0 to 5      |   |
| Fuel Sulfur (%)  | 0 to 0.5    |   |
| Temperature (°F) | -40 to 120  |   |
| Altitude*        | Low or High | (Specify high where average altitude > 5000 ft) |

\*High altitude adjustments are not included in this version of the model.

The minimum temperature that you define for your modeling scenario is the average low for the time period selected. For example, when modeling a typical summer day, the minimum temperature should be the average low temperature in Fahrenheit for the summer season. Moreover, when modeling an entire year, the minimum temperature should be the average daily low for the year and not the lowest temperature ever recorded. Other modeling parameters, such as RVP, sulfur, and oxygen content, depend on local fuel characteristics. Data for an area should be available from the state or local air agency.

To modify the options packet, follow these steps:

1. Locate the /OPTIONS/ packet.
2. Locate **Title 1**. Type in a description of your scenario. If you are interested in adding a subtitle, type that on the line **Title 2**. If you do not want a title to appear on your report, leave these fields blank.
3. For the remaining information in the /OPTIONS/ packet, change any existing information that is relevant for your run. Figure 4-3 shows the /OPTIONS/ packet with modifications for our model example.

```
-----  
1 - Char 80 - First title on reports  
2 - Char 80 - Second title on reports  
3 - Real 10 - Fuel RVP of gasoline for this simulation  
4 - Real 10 - Oxygen weight percent of gasoline for simulation  
5 - Real 10 - Percent sulfur for gasoline  
6 - Real 10 - Percent sulfur for diesel  
7 - Real 10 - Percent sulfur for LPG/CNG  
8 - Real 10 - Minimum daily temperature (deg. F)  
9 - Real 10 - maximum daily temperature (deg. F)  
10 - Real 10 - Representative average daily temperature (deg. F)  
11 - Char 10 - Flag to determine if region is high altitude  
          Valid responses are: HIGH and LOW  
12 - Char 10 - Flag to determine if RFG adjustments are made  
          Valid responses are: YES and NO  
-----  
/OPTIONS/  
Title 1          : Lawn and Garden Equipment  
Title 2          : Travis County, Summertime 1998  
Fuel RVP for gas : 9.0  
Oxygen Weight %  : 0.0  
Gas sulfur %     : 0.034  
Diesel sulfur %  : 0.33  
CNG/LPG sulfur % : 0.003  
Minimum temper. (F): 60  
Maximum temper. (F): 84  
Average temper. (F): 75  
Altitude of region : LOW  
/END/
```

Figure 4-3: Modified /OPTIONS/ packet.

### Modifying /PERIOD/

The packet /PERIOD/ defines the period of time for which emissions are to be estimated. The valid responses for the /PERIOD/ packet are as follows:

|                    |   |
|--------------------|---|
| Period type        | Annual, seasonal, or monthly            |
| Summation Type     | Typical day or period total             |
| Year of Episode    | A four-digit year between 1970 and 2050 |
| Season of year     | Winter, spring, summer, autumn          |
| Month of year      | Complete month name                     |
| Weekday or Weekend | Weekday or Weekend                      |

The season is ignored if the period type is not seasonal. Similarly, the month is ignored if the period type is not monthly. Also, weekday/weekend is ignored if summation type is period total.

To modify the /PERIOD/ packet, follow these steps:

1. Locate the /PERIOD/ packet.
2. Modify the information that is appropriate for your scenario. Figure 4-4 shows the /PERIOD/ packet with the changes required for our example.

```
1 - Char 10 - Period type for this simulation.
           Valid responses are: ANNUAL, SEASONAL, and MONTHLY
2 - Char 10 - Type of inventory produced.
           Valid responses are: TYPICAL DAY and PERIOD TOTAL
3 - Integer - year of episode (4 digit year)
4 - Char 10 - Month of episode (use complete name of month)
5 - Char 10 - Type of day
           Valid responses are: WEEKDAY and WEEKEND
-----
/PERIOD/
Period type      : seasonal
Summation type   : Period Total
Year of episode  : 1998
Season of year   : Summer
Month of year    :
Weekday or weekend :
/END/
```

Figure 4-4: Modified /PERIOD/ packet.

## Modifying /REGION/

The packet /REGION/ defines the geographic region that you are interested in modeling. In the NONROAD model, regions are defined by using two types of parameters. The first specifies the type of region. The acceptable responses for the region level are US TOTAL, 50 STATE, STATE, COUNTY, and SUBCOUNTY. The second type of parameter identifies the region codes or FIPS codes to be modeled. You can specify a global FIPS code to indicate an entire group of counties or states. For example, by entering "06000" as the FIPS code, you are specifying all of the counties in the State of California. Similarly a FIPS code of "00000" indicates all states in the United States. The first two pages of FIPS codes used in the model are listed in Appendix A; an electronic file containing all FIPS codes is contained on the NONROAD compact disc (file *fipslist.asc*) and can also be downloaded from the nonroad modeling web page.

The following table shows how the model's definition of the modeling region depends on the combination of the level and FIPS code(s) specified:

| Level    | FIPS Code   |
|----------|---|
| US TOTAL | The "FIPS code" is ignored and national estimates are calculated. This run is substantially faster than 50 STATE since no state detail or allocation is required.   |
| 50 STATE | The "FIPS code" is ignored and state-level estimates are calculated for all 50 states.  |
| STATE    | If a list of specific state FIPS codes is supplied [e.g., 06000 (for California) and 48000 (for Texas)], state-wide emissions for the defined states are produced.  |
| COUNTY   | If the global code for a state is specified (e.g., 06000), county-level estimates are calculated for all counties within the state. If a list of specific county FIPS codes is supplied, county-level estimates for just those counties will be produced. |

**SUBCOUNTY** To estimate subcounty emissions, the codes must be a combination of a single county FIPS code and a subcounty code. For example, if you were interested in modeling the Northwest portion of Washtenaw County in Michigan, you would combine the FIPS code for the county (26161) with a subcounty code (NW) to form the code 26161NW. Estimates for the sub-county level will be calculated. If this option is specified, appropriate data for subcounty resolution must also be supplied in the data files. Refer to the section on Modifying Inputs for Subcounty Runs in Chapter 6.

---

---

To modify the /REGION/ packet, follow these steps:

1. Locate the /REGION/ packet.
2. Remove, add, or change any existing information that is not relevant for your scenario. For our example, the FIPS code for Travis County, Texas is 48453 (48 designates the State of Texas; 453 is the code for Travis County). Figure 4-5 shows the /REGION/ packet with the changes required for our example.

```
US TOTAL - Nothing needs to be specified. The FIPS
          code 00000 is used automatically.

50STATE  - Nothing needs to be specified. The FIPS
          code 00000 is used automatically.

STATE    - state FIPS codes

COUNTY  - state or county FIPS codes. State FIPS
          code means include all counties in the
          state.

SUBCOUNTY - county FIPS code and subregion code.
-----
/REGION/
Region Level      :COUNTY
                  :48453
/END/
-----
```

Figure 4-5: Modified /REGION/ packet.

## Modifying /SOURCE CATEGORY/

The packet /SOURCE CATEGORY/ tells the model which source category codes (SCC) are to be processed. This is an optional packet. If the /SOURCE CATEGORY/ packet is omitted, all SCCs are processed. If you would like to model only a subset of equipment types then include the packet and your preferred list of SCCs. Running the model with only the desired equipment types can reduce model run time and help focus reports on data of particular interest.

**Tip:** Some packets in the core model, such as /SOURCE CATEGORY/, are optional and can be removed from processing by simply placing any non-blank character in the first column of the line containing the packet identifier. For example, if you wanted to “comment out” the /SOURCE CATEGORY/ packet, the first column of the packet could look like this: ,/SOURCE CATEGORY/ with the comma (,) as the non-blank character.

Each source category in the NONROAD model is uniquely identified with a source category code (SCC), which is a ten-digit number. The first two digits, 22, represent mobile sources. For most categories, the next two digits represent the engine or fuel type (60, 65, 67, 68, and 70, represent 2-stroke gasoline, 4-stroke gasoline, LPG, CNG, and diesel respectively). The next three digits represent the segment type (for example, recreational or construction). And the last three digits represent the kind of equipment (for example, golf carts or snowmobiles). For our example, the SCCs for lawn and garden equipment are 22xx004000, where xx = 60, 65, 67, 68, and 70, '004' signifies lawn and garden, and '000' indicates all types of equipment in the lawn and garden category. The SCC 2265000000 refers to all 4-stroke gasoline sources. Refer to Appendix B for a complete list of NONROAD SCCs.

To modify the /SOURCE CATEGORY/ packet, follow these steps.

1. Locate the /SOURCE CATEGORY/ packet.
2. Remove or change any existing information that is not relevant for your scenario (Figure 4-6).

```

SOURCE CATEGORY PACKET

This packet is used to tell the model which source
categories are to be processed. It is optional.
If used, only those source categories list will
appear in the output data file. If the packet is
not found, the model will process all source
categories in the population files.
-----
/SOURCE CATEGORY/
                :2260004010
                :2265004010
                :2267004010
                :2268004010
                :2270004010
/END/

```

Figure 4-6: Modified /SOURCE CATEGORY/ packet.

### **Modifying the /POP FILES/ and /ALLOC FILES/ Packet**

In the NONROAD model, there are several packets found in an option file that list the names of files that contain data used by the model to estimate emissions. To make these data files more manageable, some of the data is separated into files by state. In most cases, these files do not require any modifications if you are running the model with the default data provided.

When you modify the /REGION/ packet, specifying a different or additional state to model, then two types of data files may be affected by this modification. These two types of files are the population data files and the allocation data files and are located in the /POP FILES/ packet and the /ALLOC FILES/ packet, respectively. The /POP FILES/ packet defines the equipment population files read by the model. You can identify any number of files for a run; typically each file represents one state. The /ALLOC FILES/ packet defines the spatial allocation files read by the model. These files contain the surrogate indicators typically used to allocate from the state-level to county-level. These files are separated by state and by type of allocation indicator.

When you initially install the NONROAD model, you are prompted to identify the state where you are located. This step sets up the population and allocation factor data files for your state. If during the process of creating an option file you define a region outside of your originally defined state, you must change the state identification code of the population and allocation data files to the new state.

To modify the /POP FILES/ packet, follow these steps.

1. Locate the /POP FILES/ packet .
2. Check to see that the population data files contain the name of the state that you are interested in modeling. If not, modify the name of the population file to identify the state you want. For our example, the population file should be changed to the file for the state of Texas, “\NONROAD\DATA\POP\TX.POP”, as shown in Figure 4-7. (Since we are only interested in a county in one state in our example, only the population file for that state is required. If you were interested in multiple states, the population files for each state would be required.)

**Note:** Population data files are named using the two character state abbreviation.

```
-----  
This is the packet that defines the equipment population  
files read by the model.  
-----  
/POP FILES/                               :c:\nonroad\data\pop\tx.pop  
/END/
```

Figure 4-7: Modified /POP FILES/ packet.

To modify the /ALLOC FILES/ packet, follow these steps:

1. Locate the /ALLOC FILES/ packet.
2. As you can see in Figure 4-8, in addition to being separated by state, the allocation data files are further stratified by a series of allocation factors. Once you locate /ALLOC FILES/, check to see that the allocation data files contain the name of the state that you are interested in modeling. If not, modify the name of the allocation data files to identify the state you want. For our example, the files containing the allocation data should be changed to identify the state of Texas.

```
-----  
This is the packet that defines the spatial  
allocation files read by the model.  
-----  
  
/ALLOC FILES/  
RV Park employees :c:\nonroad\data\allocate\tx_rvprk.alo  
Golf Course estab. :c:\nonroad\data\allocate\tx_golf.alo  
Air Transportation :c:\nonroad\data\allocate\tx_airtr.alo  
Contruaction value :c:\nonroad\data\allocate\tx_const.alo  
Havested cropland :c:\nonroad\data\allocate\tx_farms.alo  
Wholesale establis.:c:\nonroad\data\allocate\tx_holsl.alo  
Family housing :c:\nonroad\data\allocate\tx_house.alo  
Logging empl. :c:\nonroad\data\allocate\tx_loggn.alo  
Landscape empl. :c:\nonroad\data\allocate\tx_lscap.alo  
Manufacturing empl.:c:\nonroad\data\allocate\tx_mnfg.alo  
Oil & gas employees:c:\nonroad\data\allocate\tx_oil.alo  
Census population :c:\nonroad\data\allocate\tx_pop.alo  
Resid. snowblower :c:\nonroad\data\allocate\tx_sbr.alo  
Comm. snowblower :c:\nonroad\data\allocate\tx_sbc.alo  
Snowmobile :c:\nonroad\data\allocate\tx_snowm.alo  
Outboard water :c:\nonroad\data\allocate\tx_wob.alo  
Inboard water :c:\nonroad\data\allocate\tx_wib.alo  
Coal mining empl. :c:\nonroad\data\allocate\tx_coal.alo  
/END/
```

Figure 4-8: Modified /ALLOC FILES/ packet.

To modify the /STAGE II/ packet, follow these steps:

1. Locate the /STAGE II / packet.
2. Once you locate /STAGE II/, check to see that the percentage reduction in refueling emissions under Stage II control reflects that of the area you are interested in modeling. If the area does not have Stage II control at the fuel pump, the effectiveness should be zero. Otherwise, enter a control effectiveness between 0 and 100 percent.

**Note:** A decimal point must be used after the percent effectiveness.

**Note:** EPA currently has no data on the effectiveness of Stage II for nonroad equipment. The value should be left at 0% unless local data exist on which a value can be based.

## Saving an Option File

After you have completed the modification of an option file to reflect the scenario that you are interested in modeling, save the file and exit the text editor.

## RUNNING THE CORE MODEL

After you have created an option file that defines the scenarios you are interested in modeling, the process of running the core model is quite simple. In Chapter 3, the steps necessary to run the core model through the graphical user interface were described. In this chapter, the steps required to run the core model through a DOS window are described.

To run the core model through a DOS window, follow these steps:

1. Open a DOS window.
2. Change to the Nonroad directory.
3. Type “*nonroad (the name of your option file).opt*” to run the core model. For example, if you were interested in running the example option file *travis.opt*, type “*nonroad travis.opt*”.
4. The model will now run with your option file. The first step that the model goes through is an initialization. During this step, the core model is reading in the option and data files and checking to ensure that all data files required to complete the run are available. After the model has initialized, it will begin the process of calculating emissions estimates based on the parameters that you set. A line on the screen will inform you of the progress of your run. When the run has finished, a message will appear indicating that the run was successfully completed (Figure 4-9).

**Note:** Most of the errors that may occur during the running of a scenario will occur during the initialization stage. If an error occurs, a message will appear on the screen notifying you of the error. Make the appropriate correction and rerun the model.

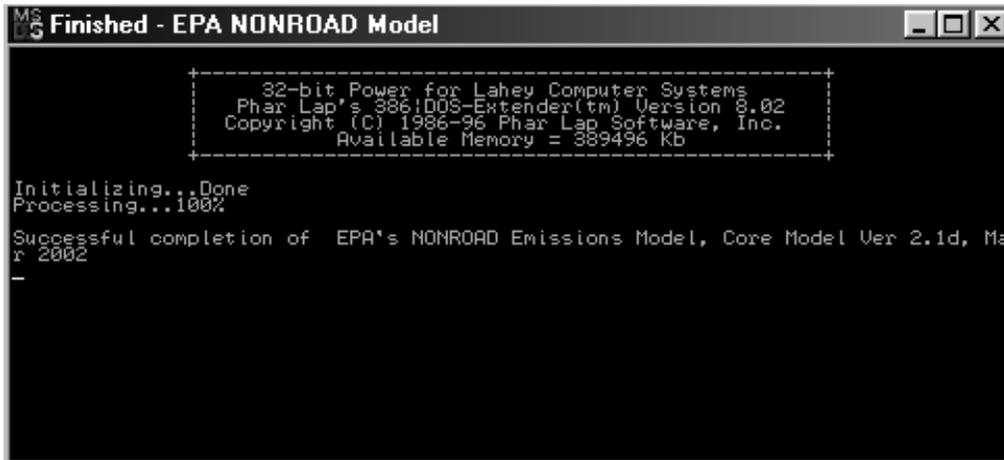


Figure 4-9: DOS window showing successful model run.

5. Review the message file associated with this run. Either type “*edit (the name of your file).msg*” or you can open the message file through a Windows text editor.

### **Error Stop Feature**

When an error occurs in the core model, an informative message is displayed in the window and written to the output message file, and the program stops. In addition to error checking, a number of conditions are checked that will produce a warning message. Warning messages are meant to inform you that a condition exists which you may want to review and correct. An example is “WARNING: Monthly seasonality factors do not add to 1. Renormalizing...” If you have included new seasonality data and thought it should sum to one, then this message would indicate either a data format problem or a typo. There are conditions which could produce many warning messages and still run to completion. In order to avoid this situation, the model will stop if 50 of the same kind of warning message is generated.

## Chapter 5

# Reporting Utility

In this chapter of the user's guide, the following topics are discussed:

- a general description of the NONROAD model Reporting Utility,
- how to import core model outputs,
- the different report types,
- how to generate and view reports, and
- how to compact databases, and how to repair corrupted databases.

### QUICK START

Each step involved in the creation of NONROAD model reports is explained in this chapter. However, to quickly create reports and view core model output data, follow these simple steps.

1. Start the reporting utility from the Reports icon created when the NONROAD model was installed on your computer, or by selecting **Model** ► **Reports** from the graphical user interface main menu. (For more information, see General Description below.)
2. Import the core model output file that you are interested in viewing by selecting **Data** ► **Import Data** from the main menu of the reporting utility. (For more information, see Importing Core Model Output below.)
3. Select the report type. From the main menu select **Reports** ► **"report name"**. Once you have selected the report that you want, specify the report options. (For more information, see Report Types and Generating Reports below.)
4. You can print the displayed report by selecting **File** ► **Print**. (For more information, see Viewing a Report in Print Preview below.)

## GENERAL DESCRIPTION

The reporting utility is used to create standardized reports using output data generated in the core model. Like the graphical user interface, the reporting utility is a fully operational Windows program designed as a separate module in order to take advantage of the many reporting and formatting options available when using a database application. Although the reporting utility is written in Microsoft Access database software, **you do not need to know how to use Access to generate reports**. Microsoft Access 2.0 allows users operating Windows 3.1 and Windows 95 to run the reporting module. If you do not have Access 2.0 (i.e., if you do not have any version of Access installed on your computer or you are using Access 97 for other database applications), the reporting utility will operate as a standalone application.

**Warning:** If you are using Access 97, **do not convert** the reporting utility from Access 2.0 to 97. The two versions are significantly different and would require major rewriting of the reporting utility modules. If you want to use Access 97 on the NONROAD reporting utility tables then make a copy of *nrdata.mdb* and convert/import the copied database into Access 97. This will preserve the reporting utility integrity and allow you the power to create custom reports.

When the NONROAD model is installed on your computer, an icon for the reporting utility is created. To start the reporting utility, double click on the reporting utility icon. Alternatively, selecting **Model ► Reports** while running the graphical user interface will also start the reporting utility.

## THE REPORTING UTILITY MENUS

Figure 5-1 shows the initial screen when the reporting utility is executed. From this screen you can access the pull down menus that make up the reporting utility.

- **File** - setup and preview a window for printing, print a window, and exit the database.
- **Reports** - select a standard report for viewing data.
- **Compare** - select a report for comparing the results of two separate modeling runs.
- **Data** - import data, remove a simulation from the database, and reattach files.

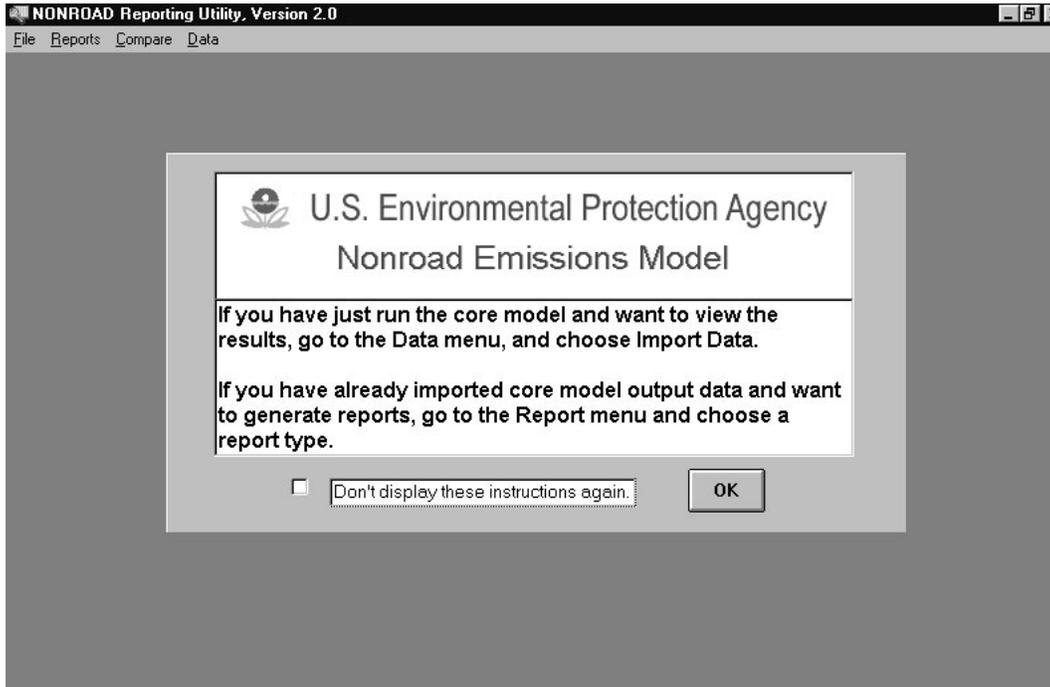


Figure 5-1: Initial report utility screen.

Once a main menu item is selected, a list of submenu items will be displayed. The following shows the list of submenu items for each of the main menu choices:

- File
  - Print Setup...
  - Print Preview
  - Print...
  - Exit
  
- Reports
  - Emissions Totals by County
  - Emissions Totals by Equipment Type
  - Emissions Totals by Horsepower
  - Emissions Totals by HP and Source Classification
  - Emissions Totals by SCC
  - Emissions Totals by Source Classification
  - Population and Fuel Consumption by HP and Source Classification
  - Population and Fuel Consumption by SCC

- Compare    Compare Two Model Runs by HP and Source Classification
- Compare Two Model Runs by Pop and Fuel
- Compare Two Model Runs by SCC
- Compare Two Model Runs by Source Classification
  
- Data        Import Data
- Remove Simulation
- Re-Attach Tables

Each submenu item opens a window where you must provide additional information. When an input error occurs, an appropriate message (dialog box) is displayed. Make the corrections needed, and continue.

## **IMPORT, DELETE, AND RE-ATTACH**

The reporting utility has been designed to run cohesively with the graphical user interface and the core model to simplify the use of the NONROAD model; if you operate the model with the default inputs provided, the process of running a simulation and generating reports is straightforward.

### **Importing Core Model Output**

In order to generate model summary reports, the reporting utility must import the output from the core model. As discussed in Chapters 3 and 4, the core model output file will have the name you assigned to it.

Follow these steps to import a core model output data file:

1. From the Main Menu, select **Data ► Import Data**.
2. Specify the core model output file in the open file dialog box.
3. A screen will appear requesting you to enter the new database table name (Figure 5-2). Type in the appropriate name of the database table. The database table name that you enter is the name that the reporting utility will recognize for all further processing of the data.

**Tip:** Because the core model was developed in Fortran, the name of the output file must be no longer than eight characters with a three character extension as a result of DOS conventions. The reporting utility allows you to name the database table using up to 30 characters. The name you give the database table can be the same as the output data file (but without the .extension since a period is not a valid table name character in Access, nor is the apostrophe). However, to help in differentiating one core model run from others, it is recommended that a more descriptive name be used.

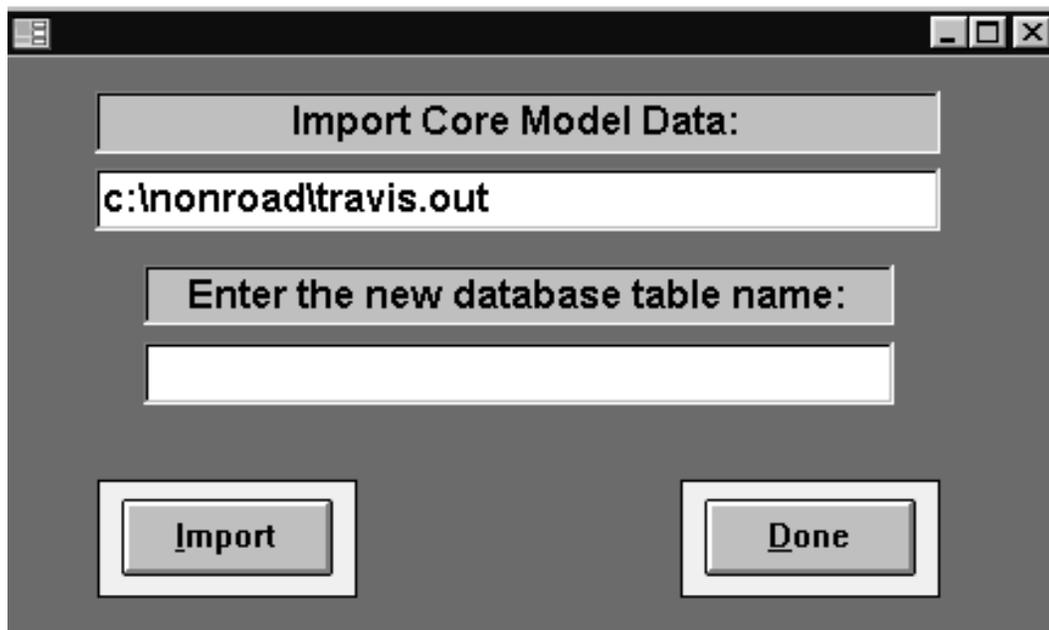


Figure 5-2: Import core model data screen.

4. After you have entered a name, **Import** the data. The bottom of the window will display a line indicating the percent completion of the import. This process may take several minutes or longer depending on the size of the database that you are processing and the speed of your computer. When the import is complete, a message box will appear indicating that the process is done. Enter **OK**.

**Note:** If you enter a name that is invalid (e.g., contains punctuation marks or has already been used), a message will appear notifying you of the problem and return you to the table name field. If this happens, simply rename the table and **Import** again.

5. Following the data import and message screen you will be requested to specify another core model output file in the open file dialog box (Step 2). You can repeat steps 2 - 4 and continue to import core model output files. When you are finished importing files select **Cancel** in the open file dialogue box to return to the main menu.

## Removing a Simulation

When an imported database table is no longer of use it can be deleted. This should only be done with the reporting utility submenu option Remove Simulation. In addition to deleting the table, the reporting utility removes records from tables it uses for processing.

**Warning:** Simulation tables should never be deleted in the NRdata database except through **Data ► Remove Simulation** in the reporting utility.

Follow these steps to delete an imported database table:

1. From the Main Menu, select **Data ► Remove Simulation**.
2. A screen appears allowing you to indicate which table you want to delete. Select the table name from the available list or type the table name in the field. When you type the table name it will automatically be expanded to match a name in the list.
3. Specify **Remove**. When the table has been successfully deleted a message box will appear indicating that the process is done. Enter **OK**.
4. Repeat steps 2 and 3 until all database tables you want to delete have been removed. Until you return to the main menu, the list of table names will show “#Deleted” for those tables which you have deleted.
5. Specify **Done**. The message, “It is advisable to compact *Nrdata.mdb* through the Nonroad Compact and Repair Utility after deleting simulations. You can do this after you close the Reporting Utility.” is displayed. Enter **OK**.

**Tip:** Following the removal of database tables, particularly large tables, it is beneficial to compact the database. Refer to the section Compacting and Repairing Databases at the end of this chapter for more details.

## Attaching the Reporting Utility Databases

When the NONROAD model is installed, a subdirectory called Reports is created. Within this subdirectory are two databases required to run the reporting utility. These databases and the information contained in each are as follows:

- *NRdata.mdb* - This database contains the example data supplied with the model and any core model output data you import.
- *Reports.mdb* - This database contains the reporting utility code and requisite data tables (such as the SCC table and FIPs county code).

**Warning:** The NRdata and Reports databases are essential to run the reporting utility. In addition, there are two tables in the NRdata database called Table Headers and Table Counties that also are essential to the operation of the reporting utility. These databases and tables should never be deleted.

To operate the reporting utility, *Reports.mdb* must have the path of *NRdata.mdb* in order to properly connect to it. The first time the reporting utility is started a screen will be displayed with the message “Attaching Tables...”. When the *Nrdata* tables have been successfully attached to the Reports database a message box will appear indicating that the operation is complete.

If you move the database tables to a new directory you will have to connect *Nrdata.mdb* to the *Reports* database. Follow these steps:

1. Select **Data ► Re-Attach Tables**.
2. If the databases reside in the same subdirectory as the reporting utility, a message box will appear indicating that tables were successfully attached. Enter **OK**. If *NRdata.mdb* resides in a different directory than *Reports.mdb*, an open file dialog box will appear. Locate the directory where the *NRdata.mdb* database resides. When *NRdata.mdb* is attached, a message box will appear indicating that the operation is done.

## REPORT TYPES

The reporting utility provides you with a set of standard reports. With the exception of the first report listed below, Emissions Totals by County, each of the reports displays the report data for either all states or counties or for a single, user-specified state or county. In addition, each of the emissions reports displays emissions for either all fuel types or for a single, user-specified fuel type. A summary of each of these reports is as follows:

***Emissions Totals by County*** - This report lists emissions by pollutant and county.

**Note:** If the output file generated in the core model contains data for multiple counties in a state the *Emissions Totals by County* report will be reported for all of these counties. If you want a separate *Emissions Totals by County* report for each county, then the core model must be run for each individual county. Once the core model has been run, you must import the output files and run the *Emissions Totals by County* using each 'county' database table.

***Emissions Totals by Equipment Type*** - This report lists emissions by pollutant for each equipment type. It is separated by major source classification (e.g., agricultural, lawn & garden, etc.) with subtotals provided for each classification. Equipment type descriptions are also included (e.g., "2-wheel tractors", "asphalt pavers", etc.). The report includes a grand total by pollutant.

***Emissions Totals by Horsepower*** - This report lists emissions by pollutant and horsepower ranges. The report includes total across all horsepower ratings by pollutant.

***Emissions Totals by HP and Source Classification*** - This report lists emissions by pollutant for each Source Classification and horsepower range. The report is separated by major equipment classification and subtotals are provided. The report includes a grand total by pollutant.

***Emissions Totals by SCC*** - This report lists emissions by pollutant for each SCC code. The report is separated by major equipment classification and subtotals are provided. In addition to the SCC code, the equipment description and engine type is provided. The report includes a grand total by pollutant.

***Emissions Totals by Source Classification*** - This report lists emissions by pollutant for each major equipment category. The report includes a grand total by pollutant.

***Population and Fuel Consumption by HP and Source Classification*** - This report lists equipment population and fuel consumption for each fuel type, source classification and horsepower range. The report is separated by fuel type and major equipment classification, and subtotals are provided. The report includes a grand total of population.

**Population and Fuel Consumption by SCC** - This report lists equipment population and fuel consumption for each SCC code. The report is separated by fuel type and major equipment classification, and subtotals are provided. In addition to the SCC code, the equipment description and engine type is provided. The report includes a grand total of population.

**Note:** Fuel consumption values are output as zero for all CNG and LPG sources.

## USER SPECIFICATIONS

To provide flexibility in designing a report, the report utility offers several report options. When you select a report type, a window appears requesting specific inputs and your choice of display options. Figure 5-3, used by most of the different report types, sets all of the report options available. The other windows used to set report options contain a subset of these options.

**Note:** Because there are different types of hydrocarbon and particulate matter emissions, the reporting utility is designed to allow you to identify the type of reporting units that you want. For hydrocarbon emissions, the core model calculates and outputs these emissions as THC (total hydrocarbon). The reporting utility has the capability to report hydrocarbons as THC, TOG (total organic gas), NMOG (non-methane organic gas), NMHC (non-methane hydrocarbon), or VOC (volatile organic compound). THC is converted to the other designations by applying appropriate factors.

For particulate matter, the core model calculates and outputs these emissions as  $PM_{10}$ . The reporting utility allows you to report particulates as  $PM_{10}$  (particulate size of 10 microns or less), or  $PM_{2.5}$  (particulate size of 2.5 microns or less).  $PM_{10}$  is converted to  $PM_{2.5}$  by applying an appropriate factor.

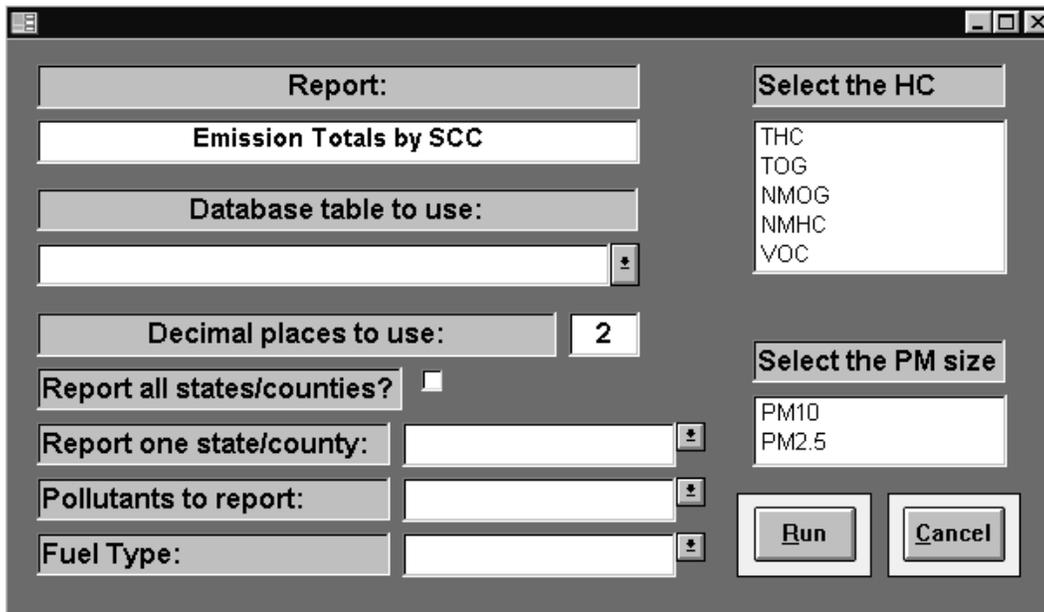


Figure 5-3: User-specified report options screen.

A brief description of the report options is provided in the table below.

| User-Specified Report Option | Description  |
|------------------------------|--|
| Database table to use        | Enter the table name that you want to use for the report (this is the name you gave the database table when you imported the file into the reporting utility as described previously in Importing Core Model Output). Select the table name from the available list or type the table name in the field. When you type the table name it will automatically be expanded to match a name in the list. |
| Decimal places to use        | The default is two decimal places for most reports. You can specify a number between 0 and 5.  |
| Report all states/counties?  | If you want to report emissions for all states or counties included in the core model output file, click in this field to specify yes. If you select all, the next report option (Report one state/county) is removed from the window.   |
| Report one state/county      | Select a state or county from the list or type the name of the state/county directly into the field. When you type the state/county name it will automatically be expanded to match a name in the list.  |

|                      |   |
|----------------------|---|
| Pollutants to report | The “pollutants to report” option allows you to select a grouping of pollutants to report. Designate the group of pollutants to report from the list of pollutant choices and descriptions. Depending on your selection, the “Select the HC” field and/or the “Select the PM size” field may be removed from the window. For example, by choosing all PM, it is no longer necessary to specify a hydrocarbon type or a particulate matter size. |
| Fuel Type            | This option allows you to report all fuels or to specify a single fuel to report. The options are All fuels, CNG, Diesel, Gasoline, and LPG. All equipment types which have lumped fuels (HP < 25) are reported as gasoline.  |
| Select the HC        | When you select a group of pollutants that include hydrocarbon emissions, you need to specify the hydrocarbon species that you want to report. Select the hydrocarbon to report (i.e, THC, TOG, NMOG, NMHC, VOC).   |
| Select the PM        | When you select a group of pollutants that include particulate emissions (with the exception of All PM) , you need to specify the particulate species that you want to report. Select the size of particulates to report (i.e., PM <sub>10</sub> , or PM <sub>2.5</sub> ).  |

**Note:** Total hydrocarbons is also reported when reporting non-exhaust hydrocarbon emissions. This occurs for the pollutant groups: All Pollutants, Non-Exhaust, and All HC.

If a single fuel is reported, other than diesel, it is important to remember that all sources with HP < 25 have been lumped into one category and will be reported as gasoline.

## GENERATING REPORTS

**Note:** All emissions are reported as short tons (i.e., 2000 lbs).

Once you have imported the necessary output files from the core model, reports can easily be generated with the reporting utility. When a report is generated, a window opens and the report is displayed in a Print Preview window.

### Running a Report

To run a report, follow these steps:

1. From the Main Menu, select **Reports** ► **“Report Name”**
2. Enter the report options. A message box is displayed when an error is detected informing you of the problem encountered. Make the necessary changes and continue.
3. After all required options have been specified, select **Run**. If a required field is left blank or an incorrect entry has been made, a message box will be displayed. You must correct the detected error and attempt to **Run** again. Once the report has been generated, it will appear in a window.
4. To return to the main menu without running the report select **Cancel**.

**Tip:** User specified report options will remain in the window until closed (Cancel). If you want to run more than one report which uses the same options window then leave the report options window open and select another report from the **Reports** submenu. The report title will be changed in the options window. Specify **RUN**. The same options (database table, decimal places, pollutants, etc.) will be used for the report. This can save you a lot of selecting/specifying report options.

### Viewing a Report in Print Preview

For easier viewing maximize the report window. As you move the cursor across the report, it changes from an arrow icon to a magnifying glass icon. To alternately zoom in or out of the report, click the mouse while the cursor is on the report.

To view a specific portion of the report:

1. Locate the desired section of the report in Zoom Out mode.

2. Zoom In to the area of interest for detailed viewing.
3. To page up or down through a multipage report, press <PgUp> or <PgDn> while in the Zoom Out mode. In either the Zoom In or Zoom Out modes, clicking on the arrows in the lower left corner of the report window or typing the page number at the bottom of the Print Preview window and pressing <Enter> will also move you to the desired page.

To provide a consistent look for all reports, the report title area for each standard report in the reporting utility is similar in design (Figure 5-4). The first two lines identify the report name and attributes which include the user-specified fuel type, report units, and the state/county specification. Following these lines are the user title lines which come from the core model output file. The next line, also coming from the core model output file, designates the period of emissions estimates. The final line of the report title area indicates the date and time that the core model run was generated and the date that the report was created.

---

---

| <b>All Fuels</b>                            | <b>Tons/Year</b> | <b>Travis County</b>   |
|---|------------------|------------------------|
| Lawn and Garden Equipment                   |                  |                        |
| Travis County Summertime 1998               |                  |                        |
| Total for Summer Season: 1998               |                  |                        |
| Date of Model Run: Tue Dec 15 17:13:41 1998 |                  | Today's Date: 12/16/98 |

---

---

Figure 5-4: Report title area.

The Reporting Utility menu bar has only one option, **File**, when viewing a report. A displayed report can be printed by selecting **File ► Print**. By selecting **File ► Print Setup** you can also modify the print setup to adjust the margins, the page orientation, and the printer selection. This may be necessary if you have pagination problems printing a report (primarily due to different printer font sizes).

**Note:** The abbreviation NA (not available) is printed in a report for entries of missing data. If a column of data contains one or more NA entries, then the subtotals and totals for that column will also be listed as NA.

Also, only sources with nonzero emissions are shown in a report. For example, if the core model output file was generated for only lawn and garden source categories, then only lawn and garden SCC codes with nonzero emissions for at least one pollutant will be reported.

**Warning:** If the format of the value to be displayed in a report column exceeds the column width then the value will be wrapped to the following line. For example,

123,456.789 might be written as 123,456.7  
89

This should only occur when you have specified more than the default number of decimal places to display. You can avoid this problem by specifying fewer decimal places to display and rerunning the report.

Appendix C contains examples of all standard reports for a core model run of Travis County, Texas emissions.

### **Exporting to Excel**

An option to export the line item report data to an Excel spreadsheet is available by selecting **File ► Export to Excel**. When selected, a dialogue box is opened to specify the Excel output file name. After the name is specified it is displayed in a window where you can select **Export Report** to create the file. When completed a message is displayed.

The spreadsheet file will contain the line item information from the report with appropriate column headings. It will not contain subtotals, grand totals, or report title information. The spreadsheet will have columns for all species and modes even though for example, you selected

to report only exhaust particulate matter. In addition, there are fields labeled “Missing species” which are used by the reporting utility for totaling purposes. The numerous additional columns can be deleted in Excel if you do not want or need them.

## COMPARING MODEL RUNS

In addition to allowing you to generate and view reports from single model runs, the reporting utility provides you with the ability to compare the results of two separate model runs. When you select **Compare** from the reporting utility main menu the comparison reports include:

- Compare Two Model Runs by HP and Source Classification
- Compare Two Model Runs by Pop and Fuel
- Compare Two Model Runs by SCC
- Compare Two Model Runs by Source Classification.

When comparing two runs, the report only shows the records that the two runs have in common. For example, if you select a report that lists information by source classification code, only that information pertaining to source classification codes that the two model runs have in common will be shown in the comparison report. Similarly, if you are interested in comparing two model runs by horsepower and source classification, you will get horsepower ranges within source classifications that the two runs have in common. If there are no common records between the two runs, you will get a message that there is nothing to report.

In order to reasonably compare values between two model runs the simulations must contain the same units. Since emissions are always output as short tons the period type must be the same between the two simulations. For example, a tons/year simulation compared to a tons/season will cause an informative message to be displayed and request you to select different tables to compare.

For the comparison reports by HP and Source Classification, SCC, and Source Classification, the report displays the results of model run 1, model run 2, the difference between model run 2 and model run 1, and the percent difference for a single user-specified pollutant. For the Pop and Fuel comparison report, the report displays only the results of model run 1 and model run 2 side by side.

To compare the results of two separate model runs, follow these steps:

1. From the Main Menu, select **Compare** ➤ **“Report Name”**
2. Enter the report options. For the comparison reports *Compare Two Model Runs by Source Classification*, *Compare Two Model Runs by SCC*, and *Compare Two Model Runs by HP and Source Classification*, the report options are shown in Figure 5-5. For the comparison report *Compare Two Model Runs by Pop and Fuel*, the report options are shown in Figure 5-6. A message box is displayed when an error is detected informing you of the problem encountered. Make the necessary changes and continue.

The screenshot shows a software dialog box with the following fields and options:

- Report:** A dropdown menu with the selected option "Compare Two Model Runs by SCC".
- 1st database table to use:** An empty dropdown menu.
- 2nd database table to use:** An empty dropdown menu.
- Decimal places to use:** A text box containing the number "2".
- Pollutants to report:** An empty dropdown menu.
- Select the HC:** A list box containing the following items: THC, TOG, NMOG, NMHC, and VOC.
- Select the PM size:** A list box containing the following items: PM10 and PM2.5.
- Buttons:** "Run" and "Cancel" buttons are located at the bottom right of the dialog.

Figure 5-5: Report options for comparing two model runs.

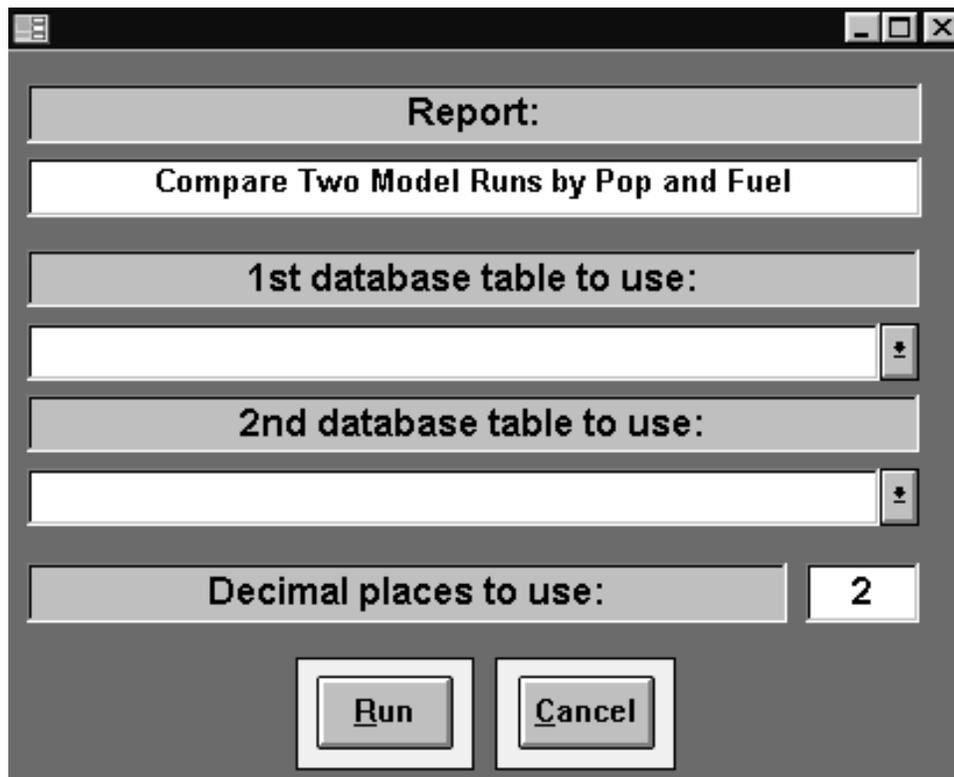


Figure 5-6: Report options for comparing two model runs by population and fuel.

3. After all required options have been specified, select **Run**. If a required field is left blank or an incorrect entry has been made, a message box will be displayed. You must correct the detected error and attempt to **Run** again. Once the report has been generated, it will appear in a window.
4. To return to the main menu without running the comparison, select **Cancel**.

Refer to the previous section on Viewing a Report in Print Preview for a discussion of viewing and printing the generated report. Examples of all comparison reports are provided in Appendix D.

## COMPACTING AND REPAIRING DATABASES

If a database contains many large tables, it may slow the operation of the reporting utility and take up substantial space on the hard drive. This is particularly true if you remove large simulations. Furthermore, a computer crash may corrupt a database. For these reasons, the model installation includes a utility that allows you to compress and repair databases. To start the Compact and Repair Utility double click on the Compact Utility icon.

**Note:** The Reporting Utility must be **closed** before running the Compact and Repair Utility.

The Compact and Repair Utility menu items are:

**File** ► **Exit** Exit the utility.

**Utilities**

- **Compact Database** Compact a selected database.
- **Repair Database** Repair a selected database.

To compact a database follow these steps:

1. Select **Utilities** ► **Compact Database**.

**Note:** To compact a database, you will need temporary storage space on your disk that is as much as the size of the \*.mdb file that you are compressing.

2. An open file dialog box appears that requests you to select the database that you want to compact. Specify the location of the *Nrdata.mdb* file.
3. A screen will appear requesting you to enter a directory for temporary storage of the compacted database (Figure 5-7). Type in the appropriate directory and path.



Figure 5-7: Identify a directory for temporary storage screen.

4. Select **Compact** to begin the compression process. Depending on the size of the database, this process may take several seconds or a few minutes. When the process is complete, a message box will be displayed indicating that the process was completed successfully and notifying you that the DOS window used to execute the move command can now be closed.

**Note:** If you are running the compact utility on a computer operating under Windows 95, activate the DOS window if it is not the active window, and click on the **X** in the upper right corner of the DOS window to return to the compact utility. For those operating under Windows 3.1, you must press **<Alt-Tab>** to get from the DOS window to the compact utility.

To repair a database that has become corrupted, follow these steps:

1. Select **Utilities** ► **Repair Database**.
2. An open file dialog box appears that requests you to select the database that you want to repair. Depending on the size of the database, this process may take several seconds or a few minutes. When the repair is complete, a message box will appear indicating that the process is done.

*December 2002*

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**ADVICE:** To prevent the accidental loss of data resulting from a damaged or corrupted database, it is strongly recommended that you routinely back-up your database

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## Chapter 6

# Advanced Topics

In this chapter of the user's guide, the following topics are discussed:

- a description of how data are grouped for use in estimating emissions,
- a description of the option file packets,
- a description of all input data files,
- information on how to incorporate local data by editing data files, and
- steps involved in running multiple model runs in a batch file.

### INTRODUCTION

The NONROAD model includes standard data files and tables that allow you to easily estimate the emissions from a wide variety of nonroad equipment and vehicles for any region of the country. As discussed in Chapters 3 and 4, you can quickly set up an option file specifying the parameters that are applicable to your modeling scenario using default data.

The NONROAD model was also designed, however, to provide you with the flexibility to create accurate emissions estimates based on locally specific data that may be available to you. For example, you may have developed more up-to-date information for equipment populations in a particular region than the default data available in the model. Similarly, you might want to estimate the emissions for a particular category of nonroad equipment at a subcounty regional level. The steps involved in modifying the default data input files and tables are provided in this chapter of the User's Guide. In addition, an example is provided for modifying inputs for subcounty runs.

While editing input files lets you adapt the model to specific local conditions, it also lets you change the model in ways that lead to invalid results. In particular, the interdependency between some inputs means that changes can affect outputs in surprising ways. The NONROAD model is designed to warn you about the most obvious input errors, but avoiding more subtle, but serious, errors requires understanding how the core model works.

You must be certain that any added data records are uniquely identified. Results will be unpredictable if there are multiple records with matching key fields that have different data values. For example, the file that contains monthly adjustment factors used to calculate the fraction of annual activity in a given month is identified by a regional and a SCC code. If you add a record to this file with the same regional and SCC code as an existing record, with differences in

the monthly distributions, then the output may not be what you intend. Searches are performed differently depending on the data file and processing routine. Do not assume that the first record matching the key fields will be used. Some searches stop at the first match, others find the last match, and still others sort the data before searching and the order of input data records is no longer significant.

**Note:** The notes in this chapter offer guidance, but EPA's technical support documents provide more detail. A list of the NONROAD technical support documents can be found in the Technical Documentation section of Chapter 1. If you have questions, e-mail EPA nonroad modeling staff at [nonroad@epa.gov](mailto:nonroad@epa.gov)

**Warning:** While editing input files lets you adapt the model to specific local conditions, there is the possibility of changing the model in ways that lead to invalid results. An understanding of data relationships is recommended before changes are made to the data files.

## HOW DATA ARE GROUPED IN THE NONROAD MODEL

As discussed briefly in Chapter 4, information used by the NONROAD model for estimating emissions, including user-specified options, data files, and data tables, are input into the core model through an option file. The information contained in each option file is separated into "packets" based on common information. For example, all data files related to the population of equipment for a modeling region is grouped in a single packet as is information related to the period of time for which you are interested in estimating emissions.

When viewing an option file through a text editor, the keyword that identifies a packet is surrounded by forward slashes ("/") and can appear in upper case, lower case, or mixed case. For example, the packet identifier for all of the data files related to the population of equipment is /POP FILES/. To designate the end, or terminator, of a packet, the keyword END is used, also surrounded by forward slashes (i.e., /END/). The /RUNFILES/, /POP FILES/, and /GROWTH FILES/ packets in an option file can be seen in Figure 6-1.

```

-----
This is the packet that lists the names of output files
and some of the input data files read by the model.
-----
/RUNFILES/
ALLOC XREF      : c:\nonroad\data\allocate\allocate.xrf
ACTIVITY       : c:\nonroad\data\activity\activity.dat
TECHNOLOGY     : c:\nonroad\data\tech\tech.dat
SEASONALITY    : c:\nonroad\data\season\season.dat
REGIONS        : c:\nonroad\data\season\season.dat
MESSAGE        : travis.msg
OUTPUT DATA   : travis.out
EPS2 AMS       : travis.ams
/END/
-----
This is the packet that defines the equipment population
files read by the model.
-----
/POP FILES/
                :c:\nonroad\data\pop\tx.pop
/END/
-----
This is the packet that defines the growth files
read by the model.
-----
/GROWTH FILES/
National defaults :c:\nonroad\data\growth\nation.grw
/END/

```

Figure 6-1: Option file showing packet identifiers and terminators.

The following packets make up the NONROAD model option file:

| Packet Identifier   | Required | Description  |
|---------------------|----------|--|
| /PERIOD/            | Yes      | Period of time to model                                      |
| /OPTIONS/           | Yes      | Run title, fuel specs, temperatures                          |
| /REGION/            | Yes      | Region to model  |
| /RUNFILES/          | Yes      | A set of input and output file names                         |
| /SOURCE CATEGORY/   | No       | Source categories to process                                 |
| /POP FILES/         | Yes      | Equipment population file names                              |
| /GROWTH FILES/      | Yes      | Projection/backcast data file names                          |
| /ALLOC FILES/       | Yes      | Spatial allocation file names                                |
| /EMFAC FILES/       | Yes      | Emission factors file names                                  |
| /DETERIORATE FILES/ | No       | Deterioration factors file names                             |
| /MODEL YEAR OUT/    | No       | By-model-year output file name                               |
| /PM BASE SULFUR/    | No       | Diesel sulfur content corresponding to base emission factors |
| /STAGE II/          | No       | Percent reduction due to Stage II control                    |

If a packet is required by the core model to estimate emissions and is not found during a run then an error message will appear and the program will stop. Each line within an option file packet begins with a 20 character label. In most cases, the core model does not read these first 20 characters as they exist simply for the purpose of identifying the information provided. For example, the line in the /OPTIONS/ packet that indicates minimum temperature ignores the 'Minimum temper. (F):' label. A few packets use these first 20 characters to specify a keyword which identifies the type of data file. For example, the /RUNFILES/ packet identifies the output message file with the keyword 'Message'.

One convenient aspect resulting from the use of a packet input structure is that packets can appear in any order in an option file. Furthermore, any type of notes or descriptions that aid in describing the packet can be placed between the individual packets. When executed, the core model searches for packet identifiers and reads the data between the identifier and the packet terminator. All other lines in the file are ignored. The file, template.opt, provided with the NONROAD model contains a complete description of each packet including format requirements.

## INPUT DATA PACKETS AND DATA FILES

As indicated above, all data input packets with the exception of that containing source category data and deterioration factor files are required for the model to accurately estimate emissions from nonroad sources. In many of these packets, data are supplied in a series of input data files. In other packets, information relevant to any scenario you are interested in modeling is supplied through user-specified options.

**Note:** To assist in better understanding the format of information in data files, it is suggested that you open each data file through a text editor as you read the information in this chapter. The data files are in a subdirectory called Data under the Nonroad directory. Each of the data files provided with the NONROAD model follows the 'packet' structure of the input option file. All files contain descriptive information including format specifications.

### Review of Previously Described Packets

Some of the NONROAD model input packets from the options file have already been discussed in Chapters 3 and 4. They are briefly reviewed here for completeness. Please refer to the previous chapters for a more complete discussion of the /OPTIONS/, /REGIONS/, /PERIOD/, and /SOURCE CATEGORY/ packets.

The /OPTIONS/ packet defines several of the user-specified options that make up a modeling scenario. /OPTIONS/ include descriptive titles, fuel specifications that will be in effect during the modeling period, and typical ambient temperatures for the period. The order of the records in this packet are fixed.

The period packet, identified as /PERIOD/, defines the period of time that you are interested in modeling. The order of the records in this packet are fixed. Furthermore, the selection of certain parameters will cause some of the records in /PERIOD/ to be ignored.

The /REGION/ packet, defines the region that you are interested in modeling. Regions are defined using two types of parameters. The first specifies the type of region and the second the region codes to be included.

The source category packet, identified as /SOURCE CATEGORY/, is used to identify which source categories are to be processed. This is an optional packet; if you do not specify a list of SCC codes, the model will calculate emissions estimates based on all source categories equipment in the population files.

### Runfiles Packet

The runfiles packet, identified as /RUNFILES/, defines input data file types required by the model and output files created (see previously referenced Figure 6-1). These data file types contain information that is universal to all regions and emissions species. Each file type is identified by a keyword(s) which appears in columns 1 to 20 of the /RUNFILES/ packet. The names for these file types may appear in any order within the packet but each must be preceded by a valid keyword.

| Keywords    | Input | Output | Required | Description                       |
|-------------|-------|--------|----------|-----------------------------------|
| ACTIVITY    | ✓     |        | ✓        | Defines equipment use per year    |
| ALLOC XREF  | ✓     |        | ✓        | Allocation indicator lookup table |
| REGIONS     | ✓     |        | ✓        | Geographic region definitions     |
| SEASONALITY | ✓     |        | ✓        | Temporal adjustment data          |
| TECHNOLOGY  | ✓     |        | ✓        | Technology type distributions     |
| MESSAGE     |       | ✓      | ✓        | Output message file               |
| OUTPUT DATA |       | ✓      | ✓        | Emission estimates (for RU)       |
| EPS2 AMS    |       | ✓      |          | Emission estimates (EPS2 format)  |

Each of the input data files contained in the /RUNFILES/ packet, along with their format, are described below.

#### ACTIVITY

The file identified by the keyword ACTIVITY, contains the activity data for the core model. *Activity.dat* is the data file provided with the NONROAD model and these default values are described in the EPA documentation report NR-005b. The activity is defined as how often a piece of equipment is used in a year. This file also contains other information about the equipment, such as average load factor and gas tank volume. Global SCC codes

can be used to indicate entire groups of equipment types. A sample of the text of the activity file shown is shown below to illustrate the look of the input file.

```

.....
-----
/ACTIVITY/
2260002006 2-Stroke Tampers/Rammers          ALL  0 9999 0.55  Hrs/Yr    160  DEFAULT
2260002009 2-Stroke Plate Compactors         ALL  0 9999 0.55  Hrs/Yr    166  DEFAULT
.....

```

The load factor (“LFac”) and annual usage (“Hours/Yr”) are both directly used to calculate the exhaust emissions. The age adjustment (AgeAdj) allows annual usage to vary with age; however, this feature is not functional in this version of the model.

In addition to providing the input data by SCC, they can be specified by region, technology type, and power level. The default NONROAD files use the same estimates for all regions (“Regio”), technology types (“TchType”), and power levels.

If alternative data exists, separate input data can be used either by modifying the entire file or including separate estimates in the same file as the default national estimates using the Region Code, which is a code defined in the temporal allocation file (“season.dat”).

Different activity by technology type was allowed with the original intention being that different technologies represented different power ranges within each application. (For example, electric lawnmowers could have been included with a zero emissions rate but with less activity than gasoline powered lawnmowers.) However because technology type is currently used to represent the emission standards, the activity for a given SCC should be the same for ALL technology types.

The activity can be a function of the power level for a given piece of equipment. For instance, a survey method produced alternative annual activity (“Hours/Yr”) for large (>25 hp) diesel construction equipment for Houston, so the alternative activity can be used along with the default information for the smaller equipment as shown in the example below.

```

.....
SCC Code   SCC Equipment Description          Regio  TchType HPmn HPmx LFac  Units  Hours/Yr  AgeAdj
/ACTIVITY/
2270002003 Diesel Pavers                    ALL    0 9999 0.59  Hrs/Yr    821  DEFAULT
2270002003 Diesel Pavers                    SW     ALL    0  25 0.59  Hrs/Yr    821  DEFAULT
2270002003 Diesel Pavers                    SW     ALL    25 9999 0.59  Hrs/Yr    719  DEFAULT
.....

```

The exhaust emissions estimates are directly related to the load factor and activity (hours/year), so a change in those estimates will proportionately affect the emissions calculated. Also, because the load factor and activity (hours/year) are used to determine the life of the equipment in years, the age distribution is affected by modifying these estimates. For instance, if activity and load factor are reduced, then the equipment will be expected to last longer in years, so the age distribution shifts to older equipment.

The format for this data is as follows:

Packet Identifier: /ACTIVITY/

| Column       | Description  |
|--------------|--|
| Line: 1 - 10 | Equipment code (SCC)   |
| 12 - 51      | Equipment description (not used)                                     |
| 52 - 56      | Region code (refer to description of REGIONS section below)          |
| 57 - 66      | Technology type  |
| 67 - 71      | Minimum horsepower   |
| 72 - 76      | Maximum horsepower   |
| 77 - 81      | Load factor  |
| 82 - 86      | (not used)   |
| 87 - 96      | Activity level units (Options: Hrs/Yr, Hrs/Day, Gal/Yr, and Gal/Day) |
| 97 - 106     | Activity level   |
| 107 - 116    | Identifier for age adjustment curve (DEFAULT=no adjustment)          |

**Warning:** The EPA does not recommend changing the activity files. This is because the activity, equipment population, load factor, and average life are all linked and changes can have surprising results. For details, see EPA’s technical documents or talk to EPA nonroad modeling staff.

ALLOC XREF

The file identified by the keyword ALLOC XREF is the allocation indicator lookup table used by the core model. *Allocate.xrf* is the data file provided with the NONROAD model. These data are used to allocate equipment type populations from one regional level to another. For each SCC in the file, the code is cross referenced to a list of indicator codes and their associated coefficients. The model will retrieve the indicator data identified by the indicator codes and calculate a linear combination. Global SCC codes can be used to indicate entire groups of equipment types.

To calculate the allocation factors, the model first calculates a linear combination of allocation indicator values. The linear combinations are defined in this file. For instance, if an SCC were discovered to be a function of two codes, then the indicator could be a combination of the two codes (e.g., RVP and POP) as shown below for a given county, and the calculation would be as follows. (This is a hypothetical example only and not an accurate reflection of in-use allocation.

$$\text{Indicator} = 0.6 * (\text{County RVP})/(\text{State RVP}) + 0.4 * (\text{County POP})/(\text{State POP})$$

$$\text{County equipment population} = \text{Indicator} * \text{State equipment population}$$

In the current version of the model, there is one indicator code assigned to each SCC. In the example below, the allocate cross reference file was modified for recreational vehicle use to reproduce the hypothetical example above.

Current Version

```
.....  
.....  
/ALLOC XREF/  
2260001000 1.0  
2260001000 RVP  
.....  
.....
```

Sample Alteration (this is not an accurate reflection of the allocation)

```
.....  
.....  
/ALLOC XREF/  
2260001000 0.6      0.4  
2260001000 RVP     POP  
.....  
.....
```

The indicator codes are arbitrary. The codes in this file are:

|     |   |
|-----|---|
| POP | Human population  |
| LSC | Employees in landscape and horticulture services                                |
| CON | Dollar value of construction  |
| MFG | Employees in manufacturing industry   |
| COM | Number of wholesale establishments  |
| LOG | Employees in lumber and wood products industry                                  |
| FRM | Harvested cropland  |
| HOU | Number of single and double family homes  |
| RVP | Number of recreational vehicle parks  |
| AIR | Employees in air transportation industry  |
| OIL | Employees in oil and gas extraction industry                                    |
| GC  | Number of public golf courses   |
| MIN | Employees engaged in coal mining  |
| SNM | Snowmobiles: state registration, snowfall, inverse human population             |
| SBR | Snowblowers residential   |
| SBC | Snowblowers commercial  |
| WIB | Recreational marine state fuel consumption, county water surface area- Inboard  |
| WOB | Recreational marine state fuel consumption, county water surface area- Outboard |

The format for this data is as follows:

Packet Identifier: /ALLOC XREF/

| Column         | Description                                    |
|----------------|--|
| Line 1: 1 - 10 | Equipment code (SCC)                           |
| 11 - 20        | Coefficient for indicator 1                    |
| 21 - 30        | Coefficient for indicator 2                    |
| 31 - 40        | Coefficient for indicator 3                    |
| Line 2: 1 - 10 | Equipment code (must match the code in Line 1) |
| 11 - 20        | Indicator code of indicator 1                  |
| 21 - 30        | Indicator code of indicator 2                  |
| 31 - 40        | Indicator code of indicator 3                  |

**Note:** If you add additional indicator codes and factors to the *allocate.xrf* file, you must also add corresponding data files. For example, if you add forest land as an allocation factor for recreational vehicles, you must provide the model with data files on forest land per county. Refer to the section Allocation Files Packet. Furthermore, the input option file must list the appropriate data file names.

REGIONS

The file identified by the keyword REGIONS, defines the states/counties in each geographic region. *Season.dat* is the data file provided with the NONROAD model. The region packet within the season file associates the region definition with the FIPS code for a State or County as shown in the example below. New regions can be defined here, but inputs for the monthly allocation (described below) must be described for any new region defined here.

```

.....
.....
/REGIONS/
SW          Southwest          48000 Texas
US          National          00000 Nation
.....
.....

```

Identification by the region code is arbitrary (SE for Southeast or SW for Southwest) but the FIPS code must be a valid state or county FIPS code. If a state code is supplied, all counties in that state are included in the indicated region, unless overridden by a county-specific record.

**Warning:** Changing the region does not change altitude or temperatures, but it does change which activity factor is applied and the allocation of activity throughout the year. In particular, if you define a new region, you must add the new region to the *activity.dat* and the *season.dat* files.

The format for this data is as follows:

Packet Identifier: /REGIONS/

| Column      | Description                     |
|-------------|---------------------------------|
| Line: 1 - 5 | User-defined region code        |
| 6 - 45      | Region description (not used)   |
| 46 - 50     | State or county FIPS code       |
| 51 - 70     | State or county name (not used) |

SEASONALITY

The file identified by the keyword SEASONALITY, contains the seasonality (temporal adjustment data) used by the core model. *Season.dat* is the data file provided with the NONROAD model. Two specific types of information are contained in this file, each identified by a different packet keyword.

The first, identified by the packet identifier /MONTHLY/, provides the monthly adjustment factors used by the model to calculate the fraction of annual activity occurring in the given month. For periods longer than a single month (e.g. season), the factors from each month spanned by the period are summed. The second, identified as /DAILY/, provides the day-of-the-week adjustments.

If no monthly or daily data for an equipment type is found in *season.dat*, a warning message is written to the output message file and the model default values will be used for temporal allocation. The default values represent an equal distribution of temporal activity throughout each month of the year. If you change the monthly allocations, you should check to make sure the allocations sum to one. Likewise, the weekend and weekday allocations should sum to one for an entire week (i.e.  $1 = 5 \times \text{weekday fraction} + 2 \times \text{weekend fraction}$ ).

The format for the monthly data is as follows:

Packet Identifier: /MONTHLY/

| Line: | Column    | Description                              |
|-------|-----------|--|
|       | 1 - 5     | Subregion code (blank = match all)       |
|       | 7 - 16    | SCC code (global codes are acceptable)   |
|       | 18 - 51   | Equipment description (not used)         |
|       | 52 - 61   | Fraction of annual activity in January   |
|       | 62 - 71   | Fraction of annual activity in February  |
|       | 72 - 81   | Fraction of annual activity in March     |
|       | 82 - 91   | Fraction of annual activity in April     |
|       | 92 - 101  | Fraction of annual activity in May       |
|       | 102 - 111 | Fraction of annual activity in June      |
|       | 112 - 121 | Fraction of annual activity in July      |
|       | 122 - 131 | Fraction of annual activity in August    |
|       | 132 - 141 | Fraction of annual activity in September |
|       | 142 - 151 | Fraction of annual activity in October   |
|       | 152 - 161 | Fraction of annual activity in November  |
|       | 162 - 171 | Fraction of annual activity in December  |

The format for the day-of-the-week data is as follows:

Packet Identifier: /DAILY/

| Column      | Description  |
|-------------|--|
| Line: 1 - 5 | Subregion code (blank = match all)                 |
| 7 - 16      | SCC code (global codes are acceptable)             |
| 18 - 51     | Equipment description (not used)                   |
| 52 - 61     | Fraction of weekly activity in typical weekday day |
| 62 - 71     | Fraction of weekly activity in typical weekend day |

**TECHNOLOGY**

The file identified by the keyword TECHNOLOGY, defines the technology type distributions for the core model. *Tech.dat* is the data file provided with the NONROAD model. The technology types are specified by SCC and horsepower range. Global SCC codes can be used to indicate entire groups of equipment types. The data in these files is separated into two lines. The first line has the identification information and a list of up to 10 technology types which make up the specified equipment population. The second line identifies the year and the fraction of population in each technology type. Multiple second lines may be provided if data is available for different years as shown in the example below. From the “tech.dat” input file (up to 10 tech types may be defined).

| Year  | SCCodes    | HPminHPmax | Tech1<br>Fract | Tech2<br>Fract | Tech3<br>Fract | Tech4 (more>)<br>Fract |
|-------|------------|------------|----------------|----------------|----------------|------------------------|
| ..... | .....      |            |                |                |                |                        |
|       | 2270000000 | 750 9999   | Base           | T0             | T1             | T2                     |
| 1900  |            |            | 1.000          | 0.000          | 0.000          | 0.000                  |
| 1988  |            |            | 0.000          | 1.000          | 0.000          | 0.000                  |
| 2000  |            |            | 0.000          | 0.000          | 1.000          | 0.000                  |
| 2006  |            |            | 0.000          | 0.000          | 0.200          | 0.800                  |
| 2007  |            |            | 0.000          | 0.000          | 0.100          | 0.900                  |
| 2013  |            |            | 0.000          | 0.000          | 0.000          | 1.000                  |
| ..... |            |            |                |                |                |                        |
| ..... |            |            |                |                |                |                        |

The fractions of population by technology type for each year should sum to 1. If the sum differs from 1.0 by more than +/- 0.002 then the fractions are normalized and a warning message is generated and displayed. The model will use the distribution beginning with the specified year, until a new distribution is provided.

The NONROAD model uses the tech types primarily to determine phase-in of emissions standards. The tech type defines the zero-hour (brand new) exhaust emission factor (derived from the emission factor files described below) and the deterioration rate. In the example above, diesel engines (SCC 227000000) of power levels between 750 and 9999

horsepower can potentially be one of 4 tech types (Base, T0, T1, T2). Older engines (starting with the 1900 model year) were exclusively the ‘Base’ tech type while new engines were produced with tech type ‘T0’ beginning with the 1988 model year. The first emission standard, Tier 1 (tech type ‘T1’) for all equipment types began with the 2000 model year. However, the Tier 2 standard is to be phased-in starting with the 2006 model year where only 80% (0.800 entry) of the new engines are expected to be Tier 2 (tech type ‘T2’) with the remainder still Tier 1.

The tech types in NONROAD have meanings that relate to the type of engine and which emission standard applies to that engine. Other tech types may appear in the default input files but have zero entries, so are not currently used. The representative tech types are as follows:

Descriptions for representative tech types.

| <b>Tech Type</b> | <b>Description</b>  |
|------------------|---|
| G2H3             | Gasoline 2-stroke handheld Class 3  |
| G2H31            | Gasoline 2-stroke handheld Class 3 meeting Phase 1 Standards  |
| G2H3C1           | Gasoline 2-stroke handheld Class 3 meeting Phase 1 Standards with a catalyst                          |
| G2H32            | Gasoline 2-stroke handheld Class 3 meeting Phase 2 Standards  |
| G2H3C2           | Gasoline 2-stroke handheld Class 3 meeting Phase 2 Standards with a catalyst                          |
| G2H4             | Gasoline 2-stroke handheld Class 4  |
| G2H41            | Gasoline 2-stroke handheld Class 4 meeting Phase 1 Standards  |
| G2H4C1           | Gasoline 2-stroke handheld Class 4 meeting Phase 1 Standards with a catalyst                          |
| G4H41            | Gasoline 4-stroke handheld Class 4 meeting Phase 1 Standards  |
| G2H42            | Gasoline 2-stroke handheld Class 4 meeting Phase 2 Standards  |
| G2H4C2           | Gasoline 2-stroke handheld Class 4 meeting Phase 2 Standards with a catalyst                          |
| G4H42            | Gasoline 4-stroke handheld Class 4 meeting Phase 2 Standards  |
| G2H5             | Gasoline 2-stroke handheld Class 5  |
| G2H51            | Gasoline 2-stroke handheld Class 5 meeting Phase 1 Standards  |
| G2H5C1           | Gasoline 2-stroke handheld Class 5 meeting Phase 1 Standards with a catalyst                          |
| G2H52            | Gasoline 2-stroke handheld Class 5 meeting Phase 2 Standards  |
| G2H5C2           | Gasoline 2-stroke handheld Class 5 meeting Phase 2 Standards with a catalyst                          |
| G4N1S            | Gasoline 4-stroke nonhandheld Class 1 side-valve carburetor   |
| G4N1O            | Gasoline 4-stroke nonhandheld Class 1 overhead-valve carburetor                                       |
| G2N1             | Gasoline 2-stroke nonhandheld Class 1   |
| G2N11            | Gasoline 2-stroke nonhandheld Class 1 meeting Phase 1 Standards                                       |
| G4N1S1           | Gasoline 4-stroke nonhandheld Class 1 side-valve carburetor meeting Phase 1 Standards                 |
| G4N1O1           | Gasoline 4-stroke nonhandheld Class 1 overhead-valve carburetor meeting Phase 1 Standards             |
| G4N1SC1          | Gasoline 4-stroke nonhandheld Class 1 side-valve carburetor meeting Phase 1 Standards with a catalyst |
| G4N1S2           | Gasoline 4-stroke nonhandheld Class 1 side-valve carburetor meeting Phase 2 Standards                 |
| G4N1O2           | Gasoline 4-stroke nonhandheld Class 1 overhead-valve carburetor meeting Phase 2 Standards             |
| G2N2             | Gasoline 2-stroke nonhandheld Class 2   |
| G4N2S            | Gasoline 4-stroke nonhandheld Class 2 side-valve carburetor   |
| G4N2O            | Gasoline 4-stroke nonhandheld Class 2 overhead-valve carburetor                                       |
| G4N2S1           | Gasoline 4-stroke nonhandheld Class 2 side-valve carburetor meeting Phase 1 Standards                 |
| G4N2O1           | Gasoline 4-stroke nonhandheld Class 2 overhead-valve carburetor meeting Phase 1 Standards             |
| G4N2S2           | Gasoline 4-stroke nonhandheld Class 2 side-valve carburetor meeting Phase 2 Standards                 |
| G4N2O2           | Gasoline 4-stroke nonhandheld Class 2 overhead-valve carburetor meeting Phase 2 Standards             |
| G4GT25           | Gasoline 4-stroke greater than 25 horsepower  |

| Tech Type | Description  |
|-----------|--|
| G2GT25    | Gasoline 2-stroke greater than 25 horsepower                       |
| R12S      | Gasoline Recreational 2-stroke                                     |
| R14S      | Gasoline Recreational 4-stroke                                     |
| LGT25     | LPG greater than 25 horsepower                                     |
| NGT25     | CNG greater than 25 horsepower                                     |
| Base      | Early uncontrolled diesel engines (pre-1988 model year engines)    |
| T0        | Late model (1988 and later model year) uncontrolled diesel engines |
| T1        | Diesel engine meeting Tier 1 Standards                             |
| T2        | Diesel engine meeting Tier 2 Standards                             |
| T3        | Diesel engine meeting Tier 3 Standards                             |
| M1        | 2-stroke gasoline outboard uncontrolled                            |
| M2        | 2-stroke gasoline personal watercraft uncontrolled                 |
| M3        | 4-stroke gasoline in-board uncontrolled                            |
| M4        | 4-stroke gasoline outboard uncontrolled                            |
| M5        | 2-stroke outboard with carburetor and ignition modifications       |
| M6        | 2-stroke outboard with modifications and catalyst                  |
| M8        | 2-stroke outboard with electronic fuel injection                   |
| M9        | Direct-injection type A outboard                                   |
| M10       | Inboard with electronic fuel injection                             |
| M13       | 4-stroke gasoline personal watercraft                              |
| M14       | 2-stroke gasoline personal watercraft with major modifications     |

New tech types may be defined for any SCC as long as the emission factors and deterioration rates are also provided for those new tech types. In many cases above, EPA has estimated what tech type of engines will be used for future year standards so the tech type descriptions and relative sales fractions may change as manufacturers introduce engines meeting the emission standards.

**Note:** Proposed regulations are estimated to reduce the number of 2-stroke engines sold in the future in favor of 4-stroke engines. Therefore, spark ignition engines of **less than 25** horsepower are lumped into one SCC category, eliminating the SCC distinction between 2- and 4-stroke gasoline, LPG, and CNG engines.

The format for the data in this file is as follows:

Packet Identifier: /TECH FRAC/

| Column          | Description   |
|-----------------|---|
| Line 1: 6 - 15  | SCC code (globals can be used)                                |
| 21 - 25         | Minimum horsepower range                                      |
| 26 - 30         | Maximum horsepower range                                      |
| 35 - ?          | List of tech type codes (each in field of 10 characters)      |
| Line 2 +: 1 - 5 | Year  |
| 35 - ?          | Fractions for each tech type (each in field of 10 characters) |

**Warning:** The technology type data are generally used with the emission factor data to model changes in control strategies. While users may wish to change the technology type data to experiment with various phase-in strategies, they should use the default values for official submittals to EPA.

### Population Files Packet

The population files packet, identified as /POP FILES/, lists all of the files containing equipment population data. The data in these files ultimately determines which equipment types will be processed in the core model. If population estimates for a given equipment type are included in any of these files, and you do not exclude the equipment from processing by user-specified options (i.e., with the /SOURCE CATEGORY/ packet in the option file), the model will use all of these population estimates to calculate emissions. The entire equipment population file will be processed and estimated emissions written to the output data file unless you specify a subset of equipment types.

For convenience and ease of data management, the population data have been disaggregated into separate files by state and a file for national totals. The /POP FILES/ packet in an option file was shown earlier in Figure 6-1.

The \*.pop files, one for each state, contain the equipment population estimates for the NONROAD model. The "\*" refers to the two character state abbreviation (*us* for the national total file). These data drive the rest of the model in terms of which equipment types will be processed. The model uses the closest year which comes before the episode year. Population estimates for an entire state may be allocated to county level (refer to the Allocation Files Packet section below). The sum of all county equipment populations within a state is equal to the state population values.

The input data are defined by the region (“FIPS” defining State or County) and year in which the estimates are valid (“Year”), SCC, and by power level grouping (“HPmin” and “Hpmax”). Subregion codes (“SUBR”) can be used to provide inputs for partial counties.

The horsepower range (HP) is lower bound exclusive and upper bound inclusive. For example, a range identified by a minimum HP of 3 and a maximum HP of 6 is the range  $3 < \text{HP} \leq 6$ . The acceptable ranges are:

|          |            |                   |
|----------|------------|-------------------|
| 0 to 1   | 25 to 40   | 600 to 750        |
| 1 to 3   | 40 to 50   | 750 to 1000       |
| 3 to 6   | 50 to 100  | 1000 to 1500      |
| 6 to 11  | 100 to 175 | 1500 to 2000      |
| 11 to 16 | 175 to 300 | 2000 to 3000      |
| 16 to 25 | 300 to 600 | Greater than 3000 |

The average of the horsepower range is used frequently in NONROAD model calculations. The option to specify a single weighted average horsepower is provided in the population file format. If the weighted average horsepower field is blank then the average is computed from the specified range.

**Note:** It is expected that in the future equipment populations will shift from 2-stroke to 4-stroke spark ignition engines. In order to allow for these predicted shifts of equipment, spark ignition engines have been grouped into single SCCs with 2-stroke, 4-stroke, CNG and LPG engines in separate technology groups. Therefore, some SCCs are missing from the population file while others have the combined populations for all spark ignition engines.

When modifying the equipment populations with local information, usually available is the total population of the equipment type, or populations within a power range. The NONROAD model needs the equipment population distributed by power level, so the revised information must be mapped into each power level range. The most widely used method for this mapping procedure is to distribute the revised population according to the default national distribution by power level range.

EPA has designed an Excel Program file that allows manipulation of the population files allowing the user to save a text file that can be used in NONROAD. With the Excel file, a column of data can replace the default data more easily than using a text editor. This file makes the redistribution method described above straight-forward.

The population file also provides the median life estimates (“Life”) and directs the model to the type of scrapage function (“ScrapFlag”) to determine the age distribution for each SCC and power level grouping. The scrapage function is defined in the growth file (named “Nation.grw”).

A change in the “Life” estimate will proportionally affect the median life in years. If the median life in years is known, then the life in hours at full load needs to be modified and can be calculated using the equation below.

$$\text{Median Life (hours at full load)} = \text{Median life (years)} * (A * LF)$$

where

- LF* = Load Factor (fraction of available power) (from Activity File)
- A* = Activity (hrs/yr) (from Activity File)
- Median Life* = Median life in hours at full load (from Population File)

The median life in years is not the same value as the average age of equipment in use. The median life is the typical age when the engine is scrapped, while the average age of equipment in-use depends upon the historic sales and the rate of scrappage. Typically the average age of equipment in-use is lower than the median life of the equipment.

The format for this data is as follows:

Packet Identifier: /POPULATION/

| Column    | Description  |
|-----------|--|
| 1 - 5     | FIPS code  |
| 7 - 11    | Subregion code (used for subcounty estimates)                        |
| 13 - 16   | Year of population estimates   |
| 18 - 27   | SCC code (no globals accepted)                                       |
| 29 - 68   | Equipment description (ignored)                                      |
| 70 - 74   | Minimum horsepower range   |
| 76 - 80   | Maximum horsepower range (ranges must match those internal to model) |
| 82 - 86   | Weighted average horsepower (optional)                               |
| 88 - 92   | Average life (in hours of use)                                       |
| 93 - 102  | Flag for scrappage distribution curve (DEFAULT = standard curve)     |
| 106 - 122 | Population estimate  |

**Warning:** The EPA does not recommend changing the equipment population files. This is because the activity, equipment population, load factor, and average life are all linked and incomplete changes can lead to surprising results. For details, see EPA’s technical documents or talk to EPA nonroad modeling staff.

### Growth Files Packet

The growth files packet, identified as /GROWTH FILES/, lists the names of all of the files containing future year projection or backcasting data (see previously referenced Figure 6-1). The growth data provided with the NONROAD model is in a single file called “*nation.grw*” and is separated into data packets. Similar to population files, growth data can be placed in separate files, such as by state or county, to simplify data management.

The packets that make up the growth files are:

| Packet Identifier     | Required | Description   |
|-----------------------|----------|---|
| /INDICATORS/          | ✓        | Cross reference between SCC and growth indicator code.                |
| /GROWTH/              | ✓        | Growth values by FIPS, indicator code, and year.                      |
| /SCRAPPAGE/           | ✓        | Default scrapage curve used for model year distribution calculations. |
| /ALTERNATE SCRAPPAGE/ |          | Alternate scrapage curve.   |

**Note:** For more information concerning how NONROAD handles growth and scrapage, consult Technical Reports NR-007a and NR-008b.

The /INDICATORS/ packet, provides a cross reference of equipment code (SCC) to growth indicator. The indicator code is an arbitrary code that identifies an actual predicted value such as human population or employment. The indicator codes may be defined by SCC (or SCC grouping following the hierarchy), power level range, and technology type. However the default values in the model only define codes applicable to all power and technology types and for general categories (construction, lawn and garden, etc.) as described in EPA’s NONROAD documentation report NR-008. Below is a sample of lines from the /INDICATORS/ packet.

```

.....
.....
FIPS  Ind  SCCodes      HPminHPmax  Tech      Description (not used)
/INDICATORS/
00000 010   2267008000    0 9999 ALL    LPG Airport Service Equipment
00000 010   2268008000    0 9999 ALL    CNG Airport Service Equipment
00000 011   2270008000    0 9999 ALL    Diesel Airport Service Equipment
.....
.....

```

The indicator codes found in the *nation.grw* file are:

|                                   |                                    |
|-----------------------------------|------------------------------------|
| 010 -- Airport Service - Total    | 061 -- Light Commercial - Diesel   |
| 011 -- Airport Service - Diesel   | 062 -- Light Commercial - Gasoline |
| 012 -- Airport Service - Gasoline | 063 -- Light Commercial - LPG      |
| 013 -- Airport Service - LPG      | 064 -- Light Commercial - CNG      |
| 014 -- Airport Service - CNG      | 070 -- Logging - Total             |
| 020 -- Construction- Total        | 071 -- Logging - Diesel            |
| 021 -- Construction - Diesel      | 072 -- Logging - Gasoline          |
| 022 -- Construction - Gasoline    | 073 -- Logging - LPG               |
| 023 -- Construction - LPG         | 074 -- Logging -CNG                |
| 024 -- Construction - CNG         | 080 -- Railway - Total             |
| 030 -- Farm - Total               | 081 -- Railway - Diesel            |
| 031 -- Farm - Diesel              | 082 -- Railway - Gasoline          |
| 032 -- Farm - Gasoline            | 083 -- Railway - LPG               |
| 033 -- Farm - LPG                 | 084 -- Railway - CNG               |
| 034 -- Farm - CNG                 | 090 -- Recreational - Total        |
| 040 -- Industrial - Total         | 091 -- Recreational - Diesel       |
| 041 -- Industrial - Diesel        | 092 -- Recreational - Gasoline     |
| 042 -- Industrial - Gasoline      | 093 -- Recreational - LPG          |
| 043 -- Industrial - LPG           | 094 -- Recreational - CNG          |
| 044 -- Industrial - CNG           | 095 -- Recreational - 2sATV        |
| 050 -- Lawn & Garden -Total       | 096 -- Recreational - 4sATV        |
| 051 -- Lawn & Garden - Diesel     | 100 -- Oil Field - Total           |
| 052 -- Lawn & Garden - Gasoline   | 101 -- Oil Field - Diesel          |
| 053 -- Lawn & Garden - LPG        | 102 -- Oil Field - Gasoline        |
| 054 -- Lawn & Garden - CNG        | 103 -- Oil Field - LPG             |
| 060 -- Light Commercial - Total   | 104 -- Oil Field - CNG             |

The format for this data is as follows:

Packet Identifier: /INDICATOR/

| Column  | Description                                  |
|---------|--|
| 1 - 5   | State/county code (FIPS)                     |
| 7 - 10  | Indicator code (arbitrary alphanumeric code) |
| 12 - 21 | Equipment code (SCC)                         |
| 23 - 27 | Minimum HP range                             |
| 28 - 32 | Maximum HP range                             |
| 34 - 43 | Technology type                              |

The /GROWTH/ packet contains the estimated values used to compute growth factors for each of the indicator codes. The /GROWTH/ data packet specifies an estimated value by state/county code (FIPS), a growth indicator code, and year. The model will use the estimated values from the two years which are closest to the base year (the year of the equipment population estimate) and the projection year (the specified episode year). It then calculates an annual growth factor based on the increase in the estimated values. The growth may be defined by State or County through the FIPS code. At least two years need to be provided to indicate a growth rate, but more may be included to provide for a variable rate over certain periods as shown in the example below.

```

.....
.....
FIPS SUBR  Year Code          Indicator Value
/GROWTH/
00000      1996  010              1000
00000      1996  011              1000
.....
.....
00000      2000  010              1240
00000      2000  011              1277
.....
.....
00000      2005  010              1553
00000      2005  011              1622
.....
.....

```

The data is easily modified by editing the text file. The growth rate is determined from the ratio of indicator values in one year compared to another, so the choice of value for the base year (1000 in the example above) is not restricted (except for zero). The indicator may be actual estimates (e.g. number of employees) or any other kind of indicator as long as it is understood that future years will be compared with the base year, so the units for the indicator must be consistent.

The resulting annual growth rate is applied to base year populations to obtain future-year predictions (or prior year backcasting) of equipment populations. Global FIPS codes can be used to provide estimated values for an entire state or even the entire country. The model will use the most refined data; county-specific where it is available.

The format for this data is as follows:

Packet Identifier: /GROWTH/

| Column  | Description  |
|---------|--|
| 1 - 5   | State/county code (FIPS)                           |
| 6 - 10  | Subregion code (blank = applies to all subregions) |
| 11 - 15 | Year of estimate (4-digit year)                    |
| 17 - 20 | Indicator code (arbitrary alphanumeric code)       |
| 26 - 45 | Estimated value                                    |

An additional packet that must appear in the growth files is the /SCRAPPAGE/ packet. This packet contains the definition of the default scrappage curve used for the model year distribution calculations. All equipment types in which the scrappage flag in the population file is set to DEFAULT will use this scrappage curve. The scrappage curve is the percentage of equipment scrapped as a function of the fraction of useful life consumed. For example, the default scrappage curve has 9 percent of equipment scrapped when the equipment has reached 45 percent of its useful life.

The format for this data is as follows:

Packet Identifier: /SCRAPPAGE/

| Column  | Description                              |
|---------|--|
| 1 - 10  | Fraction of useful life already consumed |
| 11 - 20 | Percentage of equipment scrapped         |

An optional packet of the growth data file is the /ALTERNATE SCRAPPAGE/ packet. This optional packet can be used to define scrappage curves that are used in place of the default scrappage curve for selected equipment types. To apply the /ALTERNATE SCRAPPAGE/ curve to an equipment type, you must first modify the records of the population file for the selected equipment type by changing the scrappage flag from DEFAULT to some user-defined name. The name can be any alpha-numeric string up to 10 characters in length (e.g., “chain saw” or “motorcycle”). The next step is the creation of the /ALTERNATE SCRAPPAGE/ packet. The packet is similar to the /SCRAPPAGE/ packet in form, but allows for multiple columns for defining up to 10 alternate scrappage curves for various equipment groups. The first field is the fraction of useful life consumed. The remaining columns, one for each alternate scrappage curve, contain the percentage of units scrapped. Another significant difference between this packet and the /SCRAPPAGE/ curve is that the first record is used to identify the name of the scrappage curves. These names must match the name used to replace the DEFAULT value of the scrappage flag in the population files. An example of an alternate scrappage curve is provided in *nation.grw*. These data are not referenced in the NONROAD model population files, but simply provided as an example of an alternate scrappage curve.

The format for this data is as follows:

Packet Identifier: /ALTERNATE SCRAPPAGE/

| Column   | Description                             |   |
|----------|---|---|
| Line 1:  | 1 - 10<br>11 - 20<br>21 - 30<br>x1 - x0 | not used<br>Name used to identify scrappage curve 1<br>Name used to identify scrappage curve 2<br>up to 10 curves   |
| Line 2+: | 1 - 10<br>11 - 20<br>21 - 30<br>x1 - x0 | Fraction of useful life already consumed<br>Percentage of equipment scrapped in scrappage curve 1<br>Percentage of equipment scrapped in scrappage curve 2<br>up to 10 curves |

## Allocation Files Packet

A list of spatial allocation files used by the core model is contained in the packet identified as /ALLOC FILES/. Specifically, the data in this packet is used to allocate from state-level equipment populations to county-level equipment populations. It could also be used to allocate national-level equipment populations to state-level. Alternatively, you can include additional data to allocate from county-level to subcounty-level ( an example of subcounty allocation follows the description of the allocation file data format).

As seen in Figure 6-2, the /ALLOC FILES/ packet contains numerous data files; one for each of the indicators found in the *allocate.xrf* file. Similar to the population files found in the /POP FILES/ packet, the spatial allocation data files have been segregated into separate files by state and by indicator type for convenience and ease of data management. The first 20 characters of each line are ignored and contain a description of the file. These files contain surrogate indicators used by the model for allocating equipment populations from a larger region type to a smaller region type (e.g., national-level to state-level or state-level to county-level).

Values for each indicator code are supplied both for the state total and for each county to facilitate the calculation of allocation fractions for the state equipment population. Below is a sample of the indicator values for one of the codes.

```
.....  
.....  
Column Format  
1-3      Indicator code  
6-10     FIPS code (can be global FIPS codes e.g. 06000 = all of CA)  
11-15    Subregion code (blank means is entire nation, state or county)  
16-20    Year of estimate or prediction  
21-40    Indicator value  
-----  
/INDICATORS/  
CON 48000      1997      27110368  
CON 48001      1997      21118  
CON 48003      1997      5919  
.....  
.....
```

```

-----
This is the packet that defines the spatial
allocation files read by the model.
-----
/ALLOC FILES/
RV Park employees :c:\nonroad\data\allocate\tx_rvprk.alo
Golf Course estab. :c:\nonroad\data\allocate\tx_golf.alo
Air Transportation :c:\nonroad\data\allocate\tx_airtr.alo
Contruction empl. :c:\nonroad\data\allocate\tx_const.alo
Havested Cropland :c:\nonroad\data\allocate\tx_farms.alo
Wholesale establis.:c:\nonroad\data\allocate\tx_holsl.alo
Family housing :c:\nonroad\data\allocate\tx_house.alo
Logging empl. :c:\nonroad\data\allocate\tx_loggn.alo
Landscape empl. :c:\nonroad\data\allocate\tx_lscap.alo
Manufacturing empl.:c:\nonroad\data\allocate\tx_mnfg.alo
Oil & Gas employees:c:\nonroad\data\allocate\tx_oil.alo
Census population :c:\nonroad\data\allocate\tx_pop.alo
Resid. snowblower :c:\nonroad\data\allocate\tx_sbr.alo
Comm. snowblower :c:\nonroad\data\allocate\tx_sbc.alo
Snowmobile :c:\nonroad\data\allocate\tx_snowm.alo
Outboard water :c:\nonroad\data\allocate\tx_wob.alo
Inboard water :c:\nonroad\data\allocate\tx_wib.alo
Coal mining empl. :c:\nonroad\data\allocate\tx_coal.alo
/END/

```

Figure 6-2: /ALLOC FILES/ packet.

The files provided with the NONROAD model are:

| Filename    | Indicator Description                                     |
|-------------|---|
| *_pop.alo   | Human population  |
| *_lscap.alo | Employees in landscape and horticulture services          |
| *_const.alo | Dollar value of construction                              |
| *_mnfg.alo  | Employees in the manufacturing industry                   |
| *_holsl.alo | Number of wholesale establishments                        |
| *_loggn.alo | Employees in lumber and wood products industry            |
| *_farms.alo | Harvested cropland  |
| *_house.alo | Number of single and double family homes                  |
| *_rvprk.alo | Number of recreational vehicle parks                      |
| *_airtr.alo | Employees in air transportation industry                  |
| *_oil.alo   | Employees in oil and gas extraction industry              |
| *_golf.alo  | Number of public golf courses                             |
| *_coal.alo  | Employees in coal mining                                  |
| *_sbc.alo   | Number of commercial snowblowers                          |
| *_sbr.alo   | Number of residential snowblowers                         |
| *_snowm.alo | Relative number of snowmobiles                            |
| *_wob.alo   | Water surface area for outboard recreational marine craft |
| *_wib.alo   | Water surface area for inboard recreational marine craft  |

\* Represents the two character state name abbreviation.

The format for these data is as follows:

Packet Identifier: /INDICATORS/

| Column  | Description  |
|---------|--|
| 1 - 3   | Indicator code   |
| 6 - 10  | FIPS code (can be global)                                    |
| 11 - 15 | Subregion code (blank means entire nation, state, or county) |
| 16 - 20 | Year of estimation or prediction                             |
| 21 - 40 | Indicator value  |

Modifying Inputs for Subcounty Runs

The NONROAD model has the capability of estimating emissions at a subcounty level provided that data for the subcounty level is supplied. To demonstrate how you can modify model inputs to estimate emissions at a subcounty level, we will again use the example found in Chapters 3 and 4 with the following revision:

*You have been given an assignment to estimate the total emissions from residential lawn mowers with a horsepower range of 1 to 6 in the city of Austin, Texas for summertime, 1998.*

In simple terms, the methodology that the model will use to calculate emissions from lawn mowers with a horsepower range of 1 to 6 in Austin will be to first determine the number of lawn mowers (1 to 6 HP range) in Travis County (where Austin resides) based on an allocation indicator from the state-level to the county-level, and then in the Austin metropolitan area based on an allocation indicator from the county-level to the subregion-level. The allocation indicator that will be used for this example will be housing. Once the number of lawn mowers in Travis County has been supplied (either through a separate model run or locally available data), the model will then estimate the emissions from these sources in Austin (based on the ratio of the allocation indicator value from county-level to subregion-level).

To modify the input files for this scenario, follow these steps:

1. Create a subregion code for the county which, together with the state/county code in which the subcounty is contained, will be used to identify the data applied to the subcounty. Since the Austin metropolitan area is within Travis County, Texas, a region code could be identified as '48453 Austn' where 48453 is the FIPS code for Travis County, Texas and 'Austn' is the subregion identifier for the Austin metropolitan area. The subregion identifier can only be up to five characters in length.

2. Estimate county-level equipment populations for each equipment type of interest. The most straightforward method for determining this estimate is to have the NONROAD model produce a county-level estimate using state-to-county allocation. For our example, the model would be run with the regional inputs set to

Region level : COUNTY  
FIPS code : 48453

and the /SOURCE CATEGORY/ packet modified to include Lawn and Garden residential lawn mowers.

res 2-stk mowers :2260004010  
res 4-stk mowers :2265004010  
res LPG mowers :2267004010  
res CNG mowers :2268004010  
res diesel mowers :2270004010

3. Once the core model run is completed, use the reporting utility to generate a *Population and Fuel Consumption by HP and Source Classification* report. This will provide an estimate of the population of residential lawn mowers in Travis County. Next, you must enter the county-level population data into the population files using the FIPS code for the county where your subregion is located. For our example, the population file for the state of Texas (*nonroad\data\pop\TX.pop*) would be modified as shown in Figure 6-3 where:

- 48000 is the FIPS code for the state of Texas;
- 48453 is the FIPS code for Travis County;
- 1996 is the year of population estimates;
- 2265004010 is the SCC for 2-stroke residential lawn mowers (all engine types have been lumped into this SCC);
- 1 and 3, and 3 and 6 are the minimum and maximum horsepower ranges, respectively;
- 47.9 is the expected useful life in number of hours;
- DEFAULT is the flag for scrappage distribution curve with default representing the standard curve; and
- 1737 ( $1 < \text{HP} \leq 3$ ) and 86314 ( $3 < \text{HP} \leq 6$ ) represent the population estimates.

|       |      |                |   |    |      |         |         |
|-------|------|----------------|---|----|------|---------|---------|
| 48000 | 1996 | 2265004010 ... | 1 | 3  | 47.9 | DEFAULT | 48649   |
| 48000 | 1996 | 2265004010 ... | 3 | 6  | 47.9 | DEFAULT | 2417769 |
| 48453 | 1996 | 2265004010 ... | 1 | 3  | 47.9 | DEFAULT | 1737    |
| 48453 | 1996 | 2265004010 ... | 3 | 6  | 47.9 | DEFAULT | 86314   |
| 48000 | 1996 | 2265004010 ... | 6 | 11 | 400  | DEFAULT | 797     |
| 48000 | 1996 | 2265004011 ... | 1 | 3  | 268  | DEFAULT | 1997    |
| 48000 | 1996 | 2265004011 ... | 3 | 6  | 268  | DEFAULT | 99244   |
| 48000 | 1996 | 2265004011 ... | 6 | 11 | 400  | DEFAULT | 33      |

Figure 6-3: Modified *TX.pop* file with population estimates for 2-stroke residential lawn mowers in Travis County (the SCC description, represented with three dots, has been removed from the display for readability).

With the exception of the FIPS code and the population estimate fields, the additional population county-level records will be identical to the corresponding state-level population records.

**Note:** The county-level equipment populations can be defined in a file other than the (*state name*).*pop* file. However, you must make sure that the name of this new file is listed in the /POP FILES/ packet of the options file.

- For each of the allocation indicators that are used, you must next estimate the value of the indicator within the subcounty of interest. This value should be added to the appropriate allocation file, using the county FIPS code and the subregion code as the identifier.

For our example, the allocation indicator that we will use is housing of the Austin metropolitan area which is estimated to be 112,970. To reflect this for our modeling scenario, the /INDICATOR/ packet of the housing allocation file for the state of Texas (*nonroad\data\allocate\TX\_house.alo*) would be modified as shown in Figure 6-4.

|     |       |            |        |
|-----|-------|------------|--------|
| HOU | 48449 | 1997       | 7400   |
| HOU | 48451 | 1997       | 29554  |
| HOU | 48453 | 1997       | 159111 |
| HOU | 48453 | Austn 1997 | 112970 |
| HOU | 48455 | 1997       | 4576   |
| HOU | 48479 | 1997       | 27878  |
| HOU | 48481 | 1997       | 12806  |
| HOU | 48483 | 1997       | 2609   |
| HOU | 48485 | 1997       | 40452  |

Figure 6-4: Modified *TX\_house.alo* file showing housing of Austin.

5. Next, you must modify the /REGION/ packet of the options file to indicate a subcounty run. Specify Subcounty for the region level and include the list of partial counties by listing their FIPS code/subregion code pair. Figure 6-5 shows the /REGION/ packet modified for our example.

```
The remaining records define the regions to be included.
The type of data which must be specified depends on the
region level.

US TOTAL - Nothing needs to be specified. The FIPS
           code 00000 is used automatically.

50STATE  - Nothing needs to be specified. The FIPS
           code 00000 is used automatically.

STATE    - state FIPS codes

COUNTY  - state or county FIPS codes. State FIPS
           code means include all counties in the
           state.

SUBCOUNTY - county FIPS code and subregion code.
-----
/REGION/
Region Level   :SUBCOUNTY
               :48453Austn
/END/
-----
```

Figure 6-5: Modified /REGION/ packet showing subcounty region.

**Note:** Before running your subcounty modeling scenario, make sure that the /POP FILES/ and /ALLOC FILES/ packets of the option file lists the file names of the data files containing the newly created subcounty data.

6. Once you have completed steps 1 through 5 described above, create an options file incorporating the modified packets that reflect the subregion data, save the file under an appropriate name, and run the modeling scenario.

## Emission Factors Files Packet

Simply put, emission factors are the rate at which emissions are produced for a particular process. In the NONROAD model, the names of the emission factors files for a variety of species and engine operating modes are contained in the packet identified as /EMFAC FILES/. Similar to the /RUNFILES/ packet, each filename must be preceded by a keyword. The keyword identifies the species or operating mode that is contained in the associated data file.

**Note:** The EPA does not expect users to have local data on emission factors. If you know of a study on emission factors that was not incorporated into the model inputs, please e-mail the nonroad modeling team at [nonroad@epa.gov](mailto:nonroad@epa.gov)

The valid species/modes (keywords) are as follow:

|             |              |
|-------------|--------------|
| BSFC        | SPILLAGE     |
| THC EXHAUST | DIURNAL      |
| CO EXHAUST  | CRANKCASE    |
| NOX EXHAUST | HOT SOAKS    |
| PM EXHAUST  | RUNNING LOSS |
|             | RESTING LOSS |

**Note:** SO<sub>x</sub> and CO<sub>2</sub> emissions are computed as a function of the BSFC factors and adjusted exhaust hydrocarbons, therefore there is no emission factor file for these species. Vapor displacement is computed as a function of temperature, RVP, and refueling mode (pump vs. container) so no emission factor file is required.

As seen in Figure 6-6, these species/modes are contained in separate data files. The file names can appear in any order in the packet and are identified by the keyword(s). If a species/mode is not included in an option file, all data for that species/mode will be reported as missing. For example, if there is no data file for PM emission factors, the PM field of the output data file will contain all missing values. The exception is BSFC which is a required file. In this version of the NONROAD, model hot soak emissions, running losses, and resting losses are set to zero in the output file.

```

-----
This is the packet that defines the emissions factors
files read by the model.
-----
/EMFAC FILES/
BSFC           : c:\nonroad\data\emsfac\bsfc.emf
THC EXHAUST    : c:\nonroad\data\emsfac\exhthc.emf
CO EXHAUST     : c:\nonroad\data\emsfac\exhco.emf
NOX EXHAUST    : c:\nonroad\data\emsfac\exhnox.emf
PM EXHAUST     : c:\nonroad\data\emsfac\exhpm.emf
CRANKCASE      : c:\nonroad\data\emsfac\crank.emf
DIURNAL        : c:\nonroad\data\emsfac\diurnal.emf
SPILLAGE       : c:\nonroad\data\emsfac\spillage.emf
/END/
    
```

Figure 6-6: /EMFAC FILES/ packet.

The spillage data file does not contain emission factors. It simply indicates if a source is a gasoline pump or a portable container and provides the inputs for tank volume. The equations for computing spillage and vapor displacement emissions differ for portable containers and gasoline pumps. Therefore, if the spillage file is not included in the option file then both spillage and vapor displacement emissions will be reported as missing.

Data Files in the /EMFAC FILES/ Packet

Data files provided with the NONROAD model include:

| <b>Filename</b>     | <b>Description</b>  |
|---------------------|---|
| <i>Bsfc.emf</i>     | Brake specific fuel consumption factors                                     |
| <i>Crank.emf</i>    | Emission factors data for crankcase emissions                               |
| <i>Diurnal.emf</i>  | Emission factors data for diurnal emissions                                 |
| <i>Exhco.emf</i>    | Emission factors data for exhaust CO emissions                              |
| <i>Exhnox.emf</i>   | Emission factors data for exhaust NO <sub>x</sub> emissions                 |
| <i>Exhpm.emf</i>    | Emission factors data for exhaust PM emissions                              |
| <i>Exhthc.emf</i>   | Emission factors data for exhaust THC emissions                             |
| <i>Spillage.emf</i> | Pump or container specification and tank sizes for gasoline equipment types |

The emission factors files provide the NONROAD model the zero-hour (brand new) engine exhaust emissions rates and adjustments used to determine evaporative emissions. The emission factors used in the model are described in EPA’s NONROAD documentation reports NR-009b for diesel and NR-010c for spark-ignition engines.

The exhaust emission factors files are adjusted for in-use emission rates within the NONROAD model using the information provided by the deterioration input files. The emission factors are defined by SCC, power level range, and tech type. The tech types must correspond to those provided in the tech type files so that the sales fractions of the equipment are matched to an emission factor.

Emission factor input file example (up to 10 tech types);

```

.....
.....
      2200000000      HpminHpmax      techtyT1      techtyT2      techtyT3      techtyp4      g/hp-hr      NOx
1900
/EMSFAC/
.....
.....
      2270002003      750 9999      Base      T0      T1      T2      g/hp-hr      NOx
1900
.....
.....

```

The units of the emission factor and the type of pollutant modeled must be specified. All exhaust emission factors currently are given in units of grams per horsepower-hour (g/hp-hr) or grams per mile (g/mile), but there is an option to use grams per hour (g/hr) or grams per gallon (g/gallon) and the activity rates in the activity file must be altered to match these units. The pollutants addressed by the exhaust emission factor files may be THC, CO, NOx, or PM, and the file labeled *BSFC.emf* provides the fuel consumption factors. (For the fuel consumption file no option is available for the units and must be in units of pounds per horsepower-hour.)

In calculating emissions using these files, the model will use the emission factor for the closest year that is less than or equal to the current model year. The actual emission factors could have been given specifically for the year in which they are valid, but EPA has chosen to incorporate the phase-in of emission standards through the use of the tech types rather than in the emission factor file because it is easier to incorporate phase-in and different deterioration rates using tech types for new emission standards. In the example above, while the emission factor for Tier 2 diesel pavers is valid starting in the year 1900, the fraction of Tier 2 engines is nonzero only when the technology type file shows the phase-in of this standard beginning with the 2006 model year.

The diurnal emission factor input file supplies the NONROAD model the factors in grams/tank gallon/day for use with the tank volume. The latter is calculated from the average power level supplied in the population input file multiplied by the tank volume factor supplied in the spillage input file. The diurnal input file uses the unit (g/tank) to represent the gram per tank volume gallon per day. The pollutant for diurnal emissions is, of course, THC but it still must be specified. Multiple tech types may be specified but are not currently used in the current NONROAD model, which specifies one rate for “ALL” tech types, as seen in the example below.

```

.....
.....
      2200000000      HPmn HPmx      techtyp1  techtyp2  g/hp-hr  THC
/EMSFACT/
      2260000000          0  25      ALL      g/tank    THC
1900          1.00
      2260000000      25 9999      ALL      g/tank    THC
1900          1.00
.....
.....

```

The format for the data in the BSFC and the emission factors files is as follows:

Packet Identifier: /EMSFACT/

| Column         | Description   |
|----------------|---|
| Line 1: 6 - 15 | SCC code (globals can be used)  |
| 21 - 25        | Beginning of horsepower range   |
| 26 - 30        | End of horsepower range   |
| 35 - 44        | Technology type 1   |
| x5 - x4        | Technology type 2 ... (repeating field)   |
| x5 - x4        | Units<br>options: g/hr of equipment use<br>g/hp-hr of equipment use<br>g/gallon of fuel use<br>g/tank per day per gallon of tank volume<br>g/day per calendar day<br>mult |
| x5 - x4        | Pollutant   |
| Line 2: 1 - 5  | Year  |
| 35 - 44        | Emission factors for technology type 1  |
| x5 - x4        | Emission factors for technology type 2 ... (repeating)  |

**Note:** The units field is ignored in the BSFC file; the units are lbs of fuel/hp-hr. The units field is 'MULT' in the crankcase file where the emission factor is treated as a multiplier.

The format for the data in the spillage data files is as follows:

Packet Identifier: /EMSFAC/

| Column         | Description  |
|----------------|--|
| Line 1: 1 - 10 | SCC code (globals can be used)                     |
| 12 - 20        | Refueling mode (PUMP or CONTAINER)                 |
| 22 - 25        | Range indicator (HP or TANK)                       |
| 27 - 31        | Beginning of horsepower range or tank volume range |
| 33 - 37        | End of horsepower range or tank volume range       |
| 39 - 48        | Technology type                                    |
| 50 - 59        | Units (Gallons or Gal/HP)                          |
| 61 - 70        | Tank size estimate                                 |

### Deterioration Factors Files Packet

Generally speaking, as a piece of equipment or vehicle ages over time, the rate at which pollutants are emitted increases. The data in the deterioration input files are used to adjust the emission factors for in-use deterioration, and the data used in the default files is discussed in EPA's NONROAD documentation reports NR-009b and NR-011a. The names of the files which contain the deterioration factors used by the core model to estimate this increase in emissions are contained in a packet identified as /DETERIORATE FILES/ (Figure 6-7). Similar to the /EMFAC FILES/ packet, each filename must be preceded by a keyword. The valid species/modes are the same as for the /EMFAC FILES/, with the exception that BSFC and SPILLAGE are not recognized.

```

-----
This is the packet that defines the deterioration factors
files read by the model.
-----
/DETERIORATE FILES/
THC EXHAUST      : c:\nonroad\data\defac\exthtc.det
CO EXHAUST       : c:\nonroad\data\defac\exhco.det
NOX EXHAUST      : c:\nonroad\data\defac\exhnox.det
PM EXHAUST       : c:\nonroad\data\defac\exhpm.det
/END/
    
```

Figure 6-7: /DETERIORATION FILES/ packet.

**Note:** The EPA does not expect users to have local data on deterioration factors. If you know of a study on deterioration factors that was not incorporated into the model inputs, please e-mail the nonroad modeling team at [nonroad@epa.gov](mailto:nonroad@epa.gov)

Data Files in the /DETERIORATE FILES/ Packet

The deterioration factors are specified by technology type. An “ALL” in the technology type field indicates that the deterioration factors apply to all technology types. The values are actually the coefficients of the deterioration equation

$$DF = 1 + A \times \text{engine age}^b ,$$

where A and b are provided in the file. The input file also provides a cap on the deterioration, to prevent further deterioration past a certain relative age. A sample of the look and estimates in a deterioration file is shown in the example below.

```

.....
.....
Tech Type           A coeff    b coeff    Age Cap Pollutant
/DETFAC/
.....
.....
Base                0.024      1.0        1.0      NOx
T0                  0.024      1.0        1.0      NOx
T1                  0.024      1.0        1.0      NOx
T2                  0.009      1.0        1.0      NOx
T3                  0.008      1.0        1.0      NOx
.....
.....

```

Data provided with the NONROAD model include:

| Filename          | Description  |
|-------------------|--|
| <i>Exhco.det</i>  | Deterioration factors data for exhaust CO emissions              |
| <i>Exhnox.det</i> | Deterioration factors data for exhaust NO <sub>x</sub> emissions |
| <i>Exhpm.det</i>  | Deterioration factors data for exhaust PM emissions              |
| <i>Exhthc.det</i> | Deterioration factors data for exhaust THC emissions             |

The format for the data in deterioration factors files is as follows:

| Packet Identifier: /DETFAC/ |                                     |
|-----------------------------|-------------------------------------|
| Column                      | Description                         |
| 1 - 10                      | Technology type                     |
| 21 - 30                     | A coefficient of equation           |
| 31 - 40                     | b coefficient of equation           |
| 41 - 50                     | Emission Cap (in median life units) |
| 51 - 60                     | Pollutant                           |

## PM Base Sulfur Packet

The /PM BASE SULFUR/ packet contains diesel sulfur weight percents corresponding to the input diesel PM emission factors for each diesel technology type. The default is 0.3300 (3300 ppm), but Tier 2 and later diesel emission factors are based on lower sulfur fuel. These values are used by the model to adjust the calculated diesel PM emissions for in-use sulfur levels that differ from these base sulfur levels. For the details of this adjustment refer to technical report NR-009b, "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling -- Compression-Ignition." As with the emission factor inputs, EPA does not expect users to have local data, and users are not expected to change anything in this packet.

The format for this data is as follows:

Packet Identifier: /PM BASE SULFUR/

| Column  | Description  |
|---------|--|
| 1 - 10  | Diesel technology type                               |
| 11 - 20 | Base sulfur wt percent; or '1.0' means no-adjustment |

The default values contained in this packet are as follows:

```
/PM BASE SULFUR/  
T2      0.2000  
T3      0.2000  
T4      0.0015  
T4N     0.0015  
/END/
```

The technology types, "T4" and "T4N," are placeholders for potential future standards and are not used in this version of the model.

## EDITING INPUT DATA PACKETS AND FILES

For an advanced user of the NONROAD model, the process of incorporating locally-derived data into the core model is relatively straightforward. To make changes to the data files, simply use a text editor such as Microsoft's Notepad or WordPad, or the Edit command in DOS, to access the data file. Once you have accessed the data file that you want to change, type the revised data in the appropriate field. Once complete, save the modified file under a new name to prevent the overwriting of default data.

**Note:** When the NONROAD model is initially installed, all data files are in a subdirectory called Data in the Nonroad directory.

There are two methods for indicating that you want to use new data files in an option file. The first is through the Advanced Options menu in the graphical user interface which is described in Chapter 3. The second is by modifying the appropriate packets in the option file through a text editor.

## MAKING MULTIPLE MODEL RUNS

Through a text editor or DOS, you can create a batch file that allows you to run the core model with many different scenarios. This capability provides you with the flexibility of setting up and running these scenarios when you have available computer time, such as in the evening. Figure 6-8 shows the batch file *milg.bat* (for Michigan lawn and garden run).

```
nonroad milg95.opt
nonroad milg96.opt
nonroad milg97.opt
nonroad milg98.opt
```

Figure 6-8: Batch file *milg.bat*.

A batch file can be easily created with a text editor. Open a text editor and simply type “*nonroad (option file).opt*” on consecutive lines for each of the option files you want to run. Save the batch file and close the editor. It is recommended that you name the file with a relevant name and the extension *.bat*.

To run a batch file in DOS, type “*(name of your batch file).bat*”. From Windows 3.1, use **File** ► **Run**. Type the name of your batch file in the dialog box and specify **OK**. From Windows 95, drag the mouse to the menu bar and **Start** ► **Run**. Type the name of your batch file in the dialog box and specify **OK**.

## Chapter 7

# Trouble Shooting

The NONROAD model does extensive validation of input data. Data initialization includes checking that each required input packet exists in the input option file and that the specified data values are within acceptable ranges. If the model detects unreasonable data, an error message is written and the program terminates. Specified data files must exist and include the necessary data elements. The messages written by the model are generally sufficient in determining where a problem exist.

### MESSAGE FILE

The output message file should be reviewed after each model run. An example of an output message file is shown in Figure 7-1.

This file includes the NONROAD model title and version number, date and time of execution, and a summary of each packet in the input option file. In addition, warning messages may be seen informing you of possible problems. Consider the message, “WARNING: Cannot find /DETERIORATE FILES/ packet of the options file. Factors for all species will be set to 1.0 (no deterioration).” You may determine that this is acceptable to you for your application. However, you may also want to review your data to determine if you can provide additional information.

In general, warning messages allow the model to make generalizations and provide a default action if a data item is not found; this includes skipping some records. It is important to note that although default action can occur it is meant to be the exception. Therefore, if the model issues the same warning message more than 50 times it will terminate processing. This ensures that lengthy runs will not process invalid data (remember, defaults are the exception).

```

EPA`s NONROAD Emissions Model, Core Model Ver 2.1d, Mar 2002      May 23 10:29:20:
2002

    *** Output Files ***

Output data file      :c:\nonroad\outputs\travis.out

    *** Input Files ***

Options file          :C:\EUDORA\ATTACH\TRAVIS.OPT
Allocation XREF file :c:\nonroad\data\allocate\allocate.xrf
Activity file         :c:\nonroad\data\activity\activity.dat
State/Regions file   :c:\nonroad\data\season\season.dat
Seasonality file     :c:\nonroad\data\season\season.dat
Tech fractions file  :c:\nonroad\data\tech\tech.dat

    *** Population Files ***

                        :c:\nonroad\data\pop\tx.pop

    *** Emission Factors Files ***

BSFC file             :c:\nonroad\data\emsfac\bsfc.emf
THC EXHAUST file      :c:\nonroad\data\emsfac\exhthc.emf
CO EXHAUST file       :c:\nonroad\data\emsfac\exhco.emf
NOX EXHAUST file      :c:\nonroad\data\emsfac\exhnox.emf
CO2 EXHAUST file      : Not Supplied.
SOX EXHAUST file      : Not Supplied.
PM EXHAUST file       :c:\nonroad\data\emsfac\exhpm.emf
CRANKCASE file        :c:\nonroad\data\emsfac\crank.emf
HOT SOAKS file        : Not Supplied.
DIURNAL file          :c:\nonroad\data\emsfac\diurnal.emf
REFUELING file        : Not Supplied.
SPILLAGE file         :c:\nonroad\data\emsfac\spillage.emf
RUNINGLOSS file       : Not Supplied.
RESTNGLOSS file       : Not Supplied.

    *** Deterioration Factors Files ***

THC EXHAUST file      :c:\nonroad\data\detfac\exhthc.det
CO EXHAUST file       :c:\nonroad\data\detfac\exhco.det
NOX EXHAUST file      :c:\nonroad\data\detfac\exhnox.det
CO2 EXHAUST file      : Not Supplied.
SOX EXHAUST file      : Not Supplied.
PM EXHAUST file       :c:\nonroad\data\detfac\exhpm.det
CRANKCASE file        : Not Supplied.
HOT SOAKS file        : Not Supplied.
DIURNAL file          : Not Supplied.
REFUELING file        : Not Supplied.
SPILLAGE file         : Not Supplied.
RUNINGLOSS file       : Not Supplied.
RESTNGLOSS file       : Not Supplied.

    *** Spatial Allocation Files ***

                        :c:\nonroad\data\allocate\tx_rvprk.alo
                        :c:\nonroad\data\allocate\tx_golf.alo

```

```

:c:\nonroad\data\allocate\tx_airtr.alo
:c:\nonroad\data\allocate\tx_const.alo
:c:\nonroad\data\allocate\tx_farms.alo
:c:\nonroad\data\allocate\tx_holsl.alo
:c:\nonroad\data\allocate\tx_house.alo
:c:\nonroad\data\allocate\tx_loggn.alo
:c:\nonroad\data\allocate\tx_lscap.alo
:c:\nonroad\data\allocate\tx_mnfg.alo
:c:\nonroad\data\allocate\tx_oil.alo
:c:\nonroad\data\allocate\tx_pop.alo
:c:\nonroad\data\allocate\tx_sbr.alo
:c:\nonroad\data\allocate\tx_sbc.alo
:c:\nonroad\data\allocate\tx_snowm.alo
:c:\nonroad\data\allocate\tx_wob.alo
:c:\nonroad\data\allocate\tx_wib.alo
:c:\nonroad\data\allocate\tx_coal.alo

*** Growth Indicator Files ***

:C:\nonroad\data\growth\nation.grw

*** Scenario Specific Parameters ***

First Title line :LAWN AND GARDEN EQUIPMENT
Second Title line :TRAVIS COUNTY SUMMERTIME
Fuel RVP (psi) : 8.00
Fuel Oxygen weight %: 0.00
Gasoline Sulfur % : 0.0340
Diesel Sulfur % : 0.3300
LPG/CNG Sulfur % : 0.0030
Minimum Temperature : 60.00
Maximum Temperature : 80.00
Average Ambient Temp: 75.00
Altitude of region :LOW
Stage II Control % : 0.00

*** Period Parameters ***

Year of Inventory :1998
Inventory for :SEASONAL period
Emissions summed for:PERIOD TOTAL
Season :SUMMER

*** Region of Interest ***

Region level : County-level estimates
Counties of Interest
:48453 - Travis County, Texas

*** Equipment Types ***

SCC codes Selected
:2260004010
:2265004010
:2267004010
:2268004010
:2270004010
```

```
**** Number of Population Records Found ****  
  
48000 Texas           :      3
```

Figure 7-1: Output message file.

## DATA FILE RELATIONSHIPS

One of the difficulties a novice user may have is understanding the relationships between different input files. The following is an example of possible problems as a result of providing some new data but not enough.

### Allocation Files

The allocation cross reference file defines for each source category the allocation indicator and a corresponding coefficient to be used to allocate equipment population. If you have local data on the use of snowmobiles in your modeling domain you can specify a new indicator code and then provide the allocation data for the new code. For example, by adding 2260001020, recreational snowmobiles, with an indicator code of SNO to the allocation cross reference file means you must provide an allocation file for the SNO indicator.

In addition, you must remember to update the options file to reference the new files and data which you have created. The packet /ALLOC FILES/ must include the new allocation filename for the SNO indicator data. And if you made changes to a copy of the cross reference file you must be sure to specify the new cross reference file name in the /RUNFILES/ packet of the options file (perhaps *alloupd.xrf*).

### Population Data

The equipment population data can contain records of any or mixed region levels and the model will use the most detailed provided. If you want to estimate county total emissions, then you can either provide state level equipment populations **and** state-to-county allocation data or you can provide county equipment populations. If equipment population is provided at the level for which emissions are being reported then, no allocation is needed. Only when equipment populations are provided at a coarser level of detail than the level you are estimating will allocation data be required.

In addition to defining equipment populations and corresponding allocation data you must also include the data file names in the /POP FILES/ and /ALLOC FILES/ packets of the input option file.